A COMMENTARY ON PLATO'S TIMAEUS

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PREFACE

JUDICIOUS readers of the following pages will assuredly not take long to discover, what the writer knows only too well, that they are marred by errors of many kinds. The problems which confront an expositor of the *Timaeus* are such that they might well demand for adequate treatment the combined attention of 'experts' in metaphysics, the pure mathematics, astronomy, medicine, psychology, and *theologia naturalis*, to say nothing of palaeography and Greek grammar. The 'experts' in these branches of knowledge being naturally too much occupied with their own work to annotate a Platonic dialogue, either the *Timaeus* must be left uncommented or one who is not an 'expert' must do what he can to elucidate it at the risk of making plenty of bad mistakes due to his inexpertness. I have taken this risk with my eyes open; if, with all my shortcomings I have been able, on some points, to contribute to a better understanding of Plato's dialogue or of the history of early Hellenic science, I shall feel amply repaid for a rather severe labour. The model I have had before me, if I may say so with becoming modesty, has all through been the one thoroughly worthy modern edition of the dialogue, T. H. Martin's *Études sur le Timée de Platon*. It is no derogation from the achievement of Martin to say that, magnificent as it was in its day, it is necessarily not fully adequate either to the present state of knowledge about early Greek science or to the present condition of textual scholarship. Were Martin alive at the present day, he would, no doubt, be able to produce a commentary immeasurably superior to anything I can offer; in the absence of a Martin I venture to attempt such a δεύτερος πλοῦς as my abilities permit.

I would take the opportunity to say something as briefly as I can about the principles which have determined the form

of my work. Primarily this book is intended as a commentary on the text contained in Professor Burnet's edition of Plato. I have therefore attempted no re-examination of manuscripts, though I have allowed myself to cite, on the authority of M. Rivaud's more recent edition of the dialogue, the readings of W where they seem to be of interest. As my main object has been all through to throw light on the matter of the dialogue, I have not discussed small textual and grammatical questions where their interest is merely textual or grammatical. At the same time I have tried, as best I can, to form a judgement for myself on the available evidence about the stages by which Plato's text has been transmitted to us, and to consider every important variant on its merits. That I have not gone very far wrong in principle is, I think, suggested by the fact that the publication of the readings of W by M. Rivaud has several times strongly confirmed and, I believe, never reversed, the conclusions I had already reached. I have also thought it my duty, wherever there seemed to be a real grammatical difficulty, to explain, and if necessary to justify, my view of the construction. I may, no doubt, often have been wrong, but I shall, at least, have given others the opportunity to show just how I have gone wrong. I could have wished to prefix a translation to my commentary, but this has been impossible in view of the already grievous bulk of the book.

With regard to my treatment of the philosophy and science of the dialogue there is just one point on which something must be said here. It has too long been the tendency of expositors to treat the theories of Timaeus as if they were so many speculations put forward by Plato as original discoveries of his own and expressive of his personal convictions. I have long felt that such a procedure is, at least, highly questionable. For one thing, it is a singular feature of the dialogue that it gives us so many emphatic warnings of the tentative and provisional character of its special theories. For another,

I had remarked, more than twenty years ago, that the physical science of Timaeus owes a very special debt to two fifth-century thinkers in particular, Empedocles and Diogenes of Apollonia, and that this curious fact requires explanation. For a third thing, ever since the publication of Burnet's text, again nearly twenty years ago, called my attention to the correct reading at 40 c 1 it has been clear to me that Timaeus intends to ascribe a motion to the earth which is not the motion in which Plato himself can be shown, if we combine the hints of the *Laws* with the explicit statement of Theophrastus, to have believed. These considerations long ago suggested to me the necessity of attempting to correlate the *Timaeus* with all that can be learned about the Pythagorean science of the fifth century. It seems probable that careful scrutiny would show that the science of Timaeus is, in the main, pretty much what might be expected from a progressive Pythagorean contemporary of Socrates, and that Plato has, at least, originated very little of it. (This would be quite consistent with the supposition that he would have been ready to accept most of it as provisionally the 'most likely story'.) The necessity of testing this hypothesis in detail must be my excuse for the length to which my commentary has been allowed to run. If it can establish itself, the *Timaeus* must become a document of first-rate importance for the history of Pythagorean science.

For different reasons it seemed to me that many students would be glad to see the utterances of Timaeus on scientific questions carefully and systematically compared with Aristotle's treatment of the same problems, and this comparison I have tried to carry out to the best of my power. I hope I shall not be thought to have been too presumptuous in my attempts to make the 'metaphysic of nature' which runs through the dialogue and that of Professor Whitehead and others among our contemporaries throw light on one another. I have felt the challenge on me to explain, if I can, why

Dr. Whitehead finds a kindred spirit in Plato's Pythagorean. It is only too possible that a layman in physics may have made some blunders in his attempts to interpret Professors Whitehead and Eddington to his fellow outsiders, but I am sure these eminent Professors will be the first to pardon such sins of inadvertence.

For the benefit of students I have freely given references throughout to standard works like Diels's *Doxographi Graeci* and *Fragmente der Vorsokratiker*, as also to the last edition of Ritter and Preller. But I may be allowed to say that it is not my habit to take my quotations second-hand. With one or two exceptions of an obvious kind, I have made a point of reading through for myself every book cited. It has been impossible for me to make any but very small changes since early in 1924, when my manuscript passed out of my own hands. This will explain why I have not made the use I should have wished to make of such works as Professor Joachim's edition of Aristotle *de Generatione*, Mr. Ross's edition of the *Metaphysics*, Professor W. Jaeger's *Aristoteles*, Professor Whitehead's *Science and the Modern World*, and others.

It only remains for me to acknowledge some of my many debts of gratitude. To my friend and old colleague Professor Burnet I owe even more than my Index can express. I owe much also for help in some troublesome and obscure matters to another old friend and colleague, Mr. W. L. Lorimer, of St. Andrews University. I have to thank the Delegates of the University Press for their readiness to undertake the work of publication, and the Press reader for his unfailing and invaluable assistance in the correction of errors and the verification of references. Whatever faults of the press remain must be ascribed to my own incuriousness or defective vision. To the University Court of St. Andrews, and especially to one gentleman whose name is an open secret, I am deeply grateful for the generosity which provided a considerable contribution towards the cost of publication.

Not for the first time I have also to thank the Society of Merton College, Oxford, who, by re-electing me to a Fellowship in the year 1901, made it possible for me to undertake in earnest a study at once so delightful and so unremunerative as that of Plato. Finally, I should like to take this opportunity of expressing to the Society of New College, Oxford, where I began my acquaintance with Greek philosophy, the gratitude I have always felt for all I learned during my four years as a Scholar of that College.

A. E. T.

EDINBURGH,
OCTOBER 1927.

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ERRATA

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23, line 4 from bottom, *for* in *read* after
35, line 6 *al.*, *for* Dercylidas *read* Dercylides
378, line 8 from bottom, *for* fire *read* five
600, line 23, *for* revised *read* revived

ADDENDA

Prolegomena, p. 14. The allusions of the *Critias* (108 a 7 δῆλον γὰρ ὡς ὀλίγον ὕστερον, ὅταν αὐτὸν δέῃ λέγειν, παραιτήσεται καθάπερ ὑμεῖς, c 5–7 τῆς ὑστέρας τεταγμένος . . . τάχα δηλώσει) are not complete proof that Plato seriously contemplated writing an *Hermocrates*.

18 c 8. W agrees with A Y against F in μηχανωμένους.

22 d–e. W has λυόμενος, so that the corruption, if, as is probable, there is one, is 'primitive'.

24 e 6. καλεῖτε] καλεῖται A (*in ras.*) F W Y. Unless, as is possible, καλεῖτε was the original reading of A, it is a necessary *conjecture* (of Bt.).

25 d 5. W according to Rivaud agrees with F in καταβραχέος. A *seems* to have originally read κάρτα βραχέος. The earliest *testimonium* is the '*crasso* limo' of Chalcidius. Dr. E. R. Bevan suggests to me that this represents a κάρτα παχέος which may be the true text. If the ρ of κάρτα were accidentally omitted in transcription and then carelessly reinserted *supra lineam* a little to the right, this might explain the corruption κατὰ βραχέος.

26 c 1. παιδικῆς is also the reading of W.

29 b 8. W agrees with F Y in ἀκινήτοις.

33 a 3. W, like Y, has ξυνιστᾶν τῷ.

35 a 4. W agrees with A F Y P in having the second αὖ περί, and in a 5 with A P Y in reading κατὰ ταὐτα.

36 a–b (notes, p. 145). Adrastus (*ap.* Theon. Smyrn., Hiller 67) and Macrobius (*Somn. Scip.* ii. 1. 23) also imply by their silence the absence of the ἀποτομή from Plato's scale.

37 c 6. τῶν ἀιδίων θεῶν. Dr. E. R. Bevan suggests to me θείων as a correction of θεῶν. But this would destroy the *chiasmus* and give ἄγαλμα a second otiose *epitheton*; γεγονός itself is the necessary and relevant *epitheton*.

39 a 1. W agrees in ἰούσης τε καὶ κρατουμένης.

39 b 4. After all χορεύοιτο would construe, if we take it as impersonal and τὰ περὶ τὰς ὀκτὼ φοράς as adverbial accusative.

40 b 8 ff. I ought to have quoted Diogenes Laertius iii. 75 γῆν δὲ πρεσβυτάτην μὲν εἶναι τῶν ἐν τῷ οὐρανῷ θεῶν, οὖσαν δ' ἐπὶ τοῦ μέσου κινεῖσθαι περὶ τὸ μέσον. The source of this statement saw that the dialogue ascribes a motion to the earth, but wrongly supposed it to be a 'diurnal revolution', as Grote did. That is, he

interpreted the dialogue in the light of the statements of Theophrastus about Plato's astronomy.

40 d 2. According to Rivaud W has δι' ὄψεως and αὖ τῶν.

40 e. The apologist Athenagoras rightly saw that the spirit of the passage is ironical, and took it to insinuate that beings who 'beget and are begotten' are not gods. This, he thinks, is why Timaeus says that it is μεῖζον ἢ καθ' ἑαυτὸν γνῶναι καὶ εἰπεῖν περὶ τῆς τῶν ἄλλων δαιμόνων γενέσεως οὔτε μαθεῖν οὔτ' ἐξειπεῖν γεννᾶσθαι θεοὺς δυνάμενος (*Apol.* xxiii).

41 a 7–8. Apparently W has the erroneous ἃ in 7; in 8 it omits the μή, reading ἐμοῦ γε θέλοντος.

41 e 5. W is to be added to the authority for χρόνων.

43 b 1. W agrees with F Y in προιέναι; in e 1 it has the inferior διαφοράς.

49 e 3. τὴν τῷδε. W, like Y, has τὴν τούτου.

55 d 3. W, like A Y, has στάς. It occurs to me, as an additional reason for preferring this to the πᾶς of F, that στάς may convey an allusion to the 'parting of the ways' and the 'Samian letter' (v. *Greek Philosophy: Thales to Plato*, 66).

My information about the readings of W is due everywhere to the edition of the dialogue by M. Rivaud.

ABBREVIATIONS

A.-H. = *The Timaeus of Plato*, edited with Introduction and Notes by R. D. Archer-Hind. London 1888.

Bt. = Professor John Burnet.

C. W. = *On the Interpretation of Plato's Timaeus.* Critical Studies with special reference to a recent edition. By J. Cook Wilson, M.A. London 1889.

Doxogr. Graec. = *Doxographi Graeci*, collegit recensuit prolegomenis indicibusque instruxit Hermannus Diels. Berolini 1879.

EGPh.[3] = *Early Greek Philosophy.* J. Burnet. Third edition. London 1920.

ERE. = *Encyclopaedia of Religion and Ethics*, edited by James Hastings, M.A., D.D. Edinburgh 1908–21.

Fr. d. Vors.[3] = *Fragmente der Vorsokratiker.* H. Diels. Third edition. Berlin 1912.

J. Phil. = *Journal of Philology.*

M. = *Études sur le Timée de Platon*, par Th. Henri Martin. Paris 1841.

R. P. = *Historia Philosophiae Graecae.* Testimonia auctorum conlegerunt notisque instruxerunt H. Ritter et L. Preller. Editio nona quam curavit Eduardus Wellmann. Gotha 1913.

St. = *Platonis Opera Omnia* recensuit et commentariis instruxit Godofredus Stallbaum. Vol. VII contains *Timaeum et Critiam.* Gotha and Erfurt 1838 (except where it is expressly stated that reference is being made to the stereotyped text of Plato edited by Stallbaum for Tauchnitz of Leipzig in 1850, and frequently reprinted).

I take the opportunity of mentioning here certain works of comparatively recent years which seem to me capital for the understanding of Plato, but are apparently still insufficiently known in our own country. (Of course I do not mean to say that I subscribe to all the special views of any of their authors.)

G. Milhaud, *Les Philosophes-géomètres de la Grèce, Platon et ses prédécesseurs.* Paris 1900.

H. Raeder, *Platons philosophische Entwickelung.* Leipzig, 1905.

L. Robin, *La Théorie platonicienne des idées et des nombres d'après Aristote.* Paris 1908.

L. Robin, *Études sur la signification et la place de la physique dans la philosophie de Platon*, Paris, 1919.

A. Levi, *Sulle interpretazioni immanentistiche della Filosofia di Platone.* Turin [undated, 1920 or 1921].

PROLEGOMENA

A. AUTHENTICITY OF THE DIALOGUE

THE *Timaeus* is one of the Platonic works respected even by the wild German 'criticism' of the second third of the nineteenth century. The philosopher Schelling, in his rash youth,[1] is perhaps the only person who ever proposed to ascribe the work to any author but Plato. Its authentication by testimony goes back almost to the time of composition. Aristotle, who frequently quotes it and criticizes doctrines expounded in it in his own cosmological writings, and elsewhere, particularly in the *de Caelo* and *de Generatione et Corruptione*, not only refers to it as 'the *Timaeus*', or, on other occasions, simply as 'Plato', but more than once formally uses the full expression 'Plato in the *Timaeus*'. Thus at *de Caelo* B 293^{b} 32, quoting what Timaeus says about the position of the earth in the οὐρανός (*Tim.* 40 b–c), he says 'as it stands written in the *Timaeus* (ὥσπερ ἐν τῷ Τιμαίῳ γέγραπται), and similarly in *de Generatione* A 315^{b} 30 he speaks of the analysis of bodies into geometrical surfaces inclined to one another (*Tim.* 54 d ff.), with the reference ὥσπερ ἐν τῷ Τιμαίῳ. Again, with reference to a question about weight, he uses at *de Caelo* Γ. 300^{a} 1 the words ὥσπερ ἐν τῷ Τιμαίῳ διώρισται, 'as has been laid down in the *Timaeus*', and at *de Generatione* B. 329^{a} 13 the account of space given in the dialogue is criticized with the words ὡς ἐν τῷ Τιμαίῳ γέγραπται. But at *de Generatione* A. 325^{b} 24 we have ὥσπερ ἐν τῷ Τιμαίῳ γέγραφε Πλάτων and *ibid.* B. 332^{a} 29 ὥσπερ ἐν τῷ Τιμαίῳ Πλάτων ἔγραψεν, 'as Plato has written (wrote) in the *Timaeus*'. Such explicit testimony from Aristotle would be conclusive of itself, and it adds nothing to note that Theophrastus in *de Sensu* §§ 83–91 treats the whole account of the sensible qualities of bodies given in our dialogue as the views of Plato. We also know, from Plutarch's essay on *The Generation of the Soul in the Timaeus*, and from references in the

[1] In the essay *Philosophie und Religion* (*Werke* vi. 36). No argument or evidence is offered in support of the paradox except that Dr. Schelling dislikes the theism of the dialogue. He afterwards withdrew his suggestion (*Werke* vii. 374), apparently from deference to Boeckh.

Commentary of Chalcidius, that the interpretation of the important section of the dialogue 34 d 10–36 b 7 gave rise to disputes in the Academy itself as early as the time of Aristotle's contemporary Xenocrates of Chalcedon, a pupil of Plato himself who succeeded Speusippus as head of the school in 335 B.C. Some notices of the views of Xenocrates have been preserved to us. Crantor, a leading disciple of Xenocrates (*c.* 300 B.C.), wrote commentaries (ὑπομνήματα) on the dialogue,[1] and his interpretation of the section just referred to, as well as that of Xenocrates, has been preserved and discussed by Plutarch. (I should say, however, that I do not believe Plutarch to have studied Xenocrates or Crantor at first hand. I think it more probable that he, and almost certain that Chalcidius, went for information about these matters to a commentary on the dialogue by the polymathic Stoic Posidonius of Apamea.) Posidonius, in the first half of the first century before Christ, was pretty obviously the source from which a good many later writers, for example Sextus Empiricus, derived much of their information about early science and philosophy, as may be shown in the proper place. The dialogue continued to be studied and commentated right down to the days of Proclus (d. A.D. 485) in the reign of the Emperor Theodosius II. All that remains to us in the way of direct exposition is the *Commentaries* of Chalcidius in the fourth and Proclus in the fifth century A.D., but the references in the work of Proclus are sufficient to show that the dialogue had been expounded in whole or in part by interpreters of every age from that of Crantor to that of Proclus himself, including all the chief figures of the Neo-Platonic succession. (Among the essays of Plotinus *Enn.* ii. 1, περὶ τοῦ κόσμου, and iv. 1–5 may almost be regarded as formal expositions of parts of the dialogue.)

In the 'Middle Ages' the chief source[2] from which Platonism was known to the western world was the Latin version of the first two-thirds of the dialogue by Chalcidius, the other two principal sources being apparently the *Consolatio* of Boethius and the exposition of Cicero's *Somnium Scipionis* by Macrobius, both works in which the *Timaeus* is very largely drawn upon. This explains why Platonism means to the great schoolmen of the thirteenth century principally the *Timaeus*,[3] and again why it is so largely the

[1] Proclus in *Timaeus* (Diehl) i. 76 ὥσπερ ὁ πρῶτος τοῦ Πλάτωνος ἐξηγητὴς Κράντωρ.

[2] Apart from the polemical references in Aristotle.

[3] And, we might add, the *Phaedo*, a dialogue referred to with exceptional frequency by Aristotle.

real or supposed teachings of our dialogue which determine the character of the renewed 'Platonism' of the age of the 'revival of learning'.

One or two attempts have been made in Germany in recent years to dispute the literary unity of the dialogue or to discover discrepancies which suggest that different parts of it were composed at long intervals of time. These are best noticed in connexion with the particular passages which have been made the occasion for them. I shall not discuss them here as I believe that my notes on the places where there are real incoherencies in the doctrines of Timaeus will make it clear that such incoherencies are inevitable, and that no inference can be drawn from their occurrence to the manner in which the dialogue was composed. The latest attempt of this kind is made by Wilamowitz in his account of the dialogue in his voluminous *Platon* (1917–18). Like some other expositors before him, Wilamowitz detects in certain parts of the *Timaeus* allusions to the peculiar doctrines of Democritus. Unlike his predecessors, he holds that the allusions show that Plato was still unacquainted with the system of Democritus when he planned and began the *Timaeus*. Midway in the task of composition he studied Democritus and found in his writings a closely-knit system of purely 'naturalistic' science, which compelled Plato in the very middle of the work (*Tim.* 48 a) to go back upon his own tracks and introduce far-reaching modifications of the general scheme of thought laid down earlier (*Tim.* 29 d) in order to bring Democritean 'naturalism' within the scope of his refutation. I believe I shall be able to show against all theories of this type that there are no traces anywhere in Plato of a knowledge of Democritus, and that in the *Timaeus* in particular the whole plan of the dialogue makes such references impossible. The question can only be dealt with properly in commenting on the passages where the special allusions have been supposed to occur.

B. DATE OF COMPOSITION

Since the dialogue opens with a recapitulation of a great part of the *Republic* (*Tim.* 17 c 1–19 b 2), it must, of course, be later than that work, or, if we accept the really groundless speculations of some modern writers about an earlier and a later version of the *Republic*, later than the composition of all but the central books of the *Republic* (vi–vii), to which the summary of the *Timaeus* makes

no reference. Beyond this we have nothing but stylistic evidence to go upon, as the *Timaeus* contains not a single certain allusion to historical events of Plato's own age which would furnish us with a *terminus a quo*. The evidence from style is, however, so far as it goes, unmistakable. For details I must be content to refer to such works as C. Ritter's *Untersuchungen über Platon* and Lutoslawski's *Origin and Growth of Plato's Logic*, pt. i. The main point is that a whole series of dialogues, *Sophistes*, *Politicus*, *Timaeus*, *Philebus*, *Laws*, exhibit marked peculiarities of style which distinguish them from other Platonic works. Apart from lesser peculiarities the features common to all these works are these: (1) the dramatic element, though never wholly wanting, is reduced to a minimum; (2) Socrates (except in the *Philebus*, the only work of the series which deals with a distinctively ethical problem such as the actual Socrates might well have discussed) plays a minor part and, in the *Laws*, is absent altogether; (3) the leading speaker in every case has a very positive doctrine to teach, and, especially in the *Timaeus* and *Laws*, adopts the manner of a continuous lecturer for many pages together; (4) there is an increasing tendency to employ a periodic style, quite unlike that of other dialogues and obviously modelled on the pattern of Isocrates. This means that Plato is trying to adapt the style invented for the topical pamphlet by Isocrates to the purposes of sustained philosophical and scientific exposition, and he even uses for this object some of the special 'graces' of Isocrates, such as the avoidance of hiatus. The general effect is that we no longer have that approximation to the tone of well-bred conversation which is so characteristic of the *Gorgias*, *Phaedo*, *Republic*; we are getting something much more like a formal treatise or essay.

We may, then, reasonably regard the whole series of works, *Sophistes*, *Politicus*, *Timaeus*, *Philebus*, *Laws*, as belonging to the later period of Plato's life. As most of the peculiarities of style remarked upon seem to be least prominent in the *Sophistes* and *Politicus* and most marked of all in the *Laws*, which appear to allude to events of the latest years of Plato's life and are represented by a good ancient tradition as having been circulated only after his death, we may reasonably regard the *Sophistes* and *Politicus* as opening the group and the *Laws* as closing it. (At the same time we must be prepared for the possible modification of our conclusions by the result of the careful study of the rhythm of *clausulae* in Plato which has been begun by an article of Mr. Billig in *Journal of*

Philology xxxv, p. 225 ff. How far further investigation will confirm Mr. Billig's conclusions remains to be seen. I do not think that the complete confirmation of them would make much difference to the results at which I have tried to arrive provisionally in the next paragraph on grounds of a different kind.)

Any attempt at more exact dating is necessarily conjectural. It is now pretty generally recognized that, in spite of the special pleading of Natorp (*Platons Ideenlehre* pp. 88 ff.), the latest of the dialogues which do not show the peculiarities enumerated above must be the *Theaetetus*, philosophically the ripest of the whole group (with a possible exception for the *Parmenides*, if that dialogue and the *Theaetetus* were not composed simultaneously), and that the marked change in style in the *Sophistes*, where we begin to trace the influence of Isocrates, is best explained by supposing that there had been a break of some years in Plato's literary work. Now the *Theaetetus* can be approximately dated with some certainty. It relates in its proem that the Athenian mathematician Theaetetus, a leading member of the Platonic Academy in its first generation, has been badly wounded in a battle on the Isthmus of Corinth, and is being carried home to Athens in a critical condition. This gives occasion to the speakers to lament the loss which the death of such a man will be to science, and to recall the admiration Socrates had expressed for his ability in his mere boyhood, a few weeks before his own death (i.e. in the spring of 399 B.C.) From the tone of these remarks it is plain that Theaetetus died of his wounds, and that Plato is paying a tribute to an associate whom he had recently lost. (We must remember that Theaetetus was, to all appearances, almost the chief mathematician of his generation. In particular, he did much to lay the foundations of solid geometry as we have it in Euclid xi–xiii, a science which, as we are told in the *Republic* (528 b), was hardly yet 'invented' in the time of Socrates, though Socrates was well aware that its 'invention' was a *desideratum*. He was also one of the first authors of the scientific study of the 'quadratic surds' represented for us by Euclid's Tenth Book.) It seems almost certain that the battle in which Theaetetus was fatally wounded was the battle of Corinth of 369 B.C. (See E. Sachs *de Theaeteto Atheniensi* pp. 22 ff.) Professor Lewis Campbell, in the Introduction to his edition of the *Theaetetus* disputes this identification, originally made by E. Munk, on the rather fanciful ground that the pathos of the dialogue is spoiled if Theaetetus is supposed to have outlived early youth. But that

he did live to a much later age is sufficiently proved by the very words of the dialogue itself, 142 b 6, οἷον ἄνδρα λέγεις ἐν κινδύνῳ εἶναι. Not to say that the statements of Proclus *In Euclidis Lib.* i (ed. Friedlein) pp. 66–7 distinctly imply that the mathematical work of Theaetetus was done *in the Academy* in conjunction with Eudoxus and others, and it is almost certain that Proclus is here taking his historical facts ultimately from Eudemus, an unimpeachable authority. It is therefore out of the question to suppose, as Professor Campbell too hastily did, that the battle in which Theaetetus was wounded was that of 394, and no other battle which suits Plato's references is known between 394 and 369.

Presumably then, if Theaetetus died in 369, the dialogue which dwells on his recent death should belong to the next year or so, and we may date its composition approximately in 368 or 367. Now 367 was the year in which Plato was called to Syracuse by Dion to undertake the political education of Dionysius II. From this time until his return from his second and last visit to Dionysius in 360, what with his connexion with the troublesome politics of Syracuse and his work as head of a great school of science and jurisprudence, Plato can have had little leisure to write books. Hence I think it most probable that the *Sophistes* is not earlier than 360, seven or eight years after the *Theaetetus*.

We might, indeed, have to modify this conclusion if we could identify the *Sophistes* and *Politicus*, as has sometimes been done, with the Διαιρέσεις or logical 'divisions' to which Aristotle refers in the *de Generatione* B. 330^{b} 15 in connexion with the number of the 'elements' (ὡσαύτως καὶ οἱ τρία λέγοντες, καθάπερ Πλάτων ἐν ταῖς διαιρέσεσιν· τὸ γὰρ μέσον μῖγμα ποιεῖ). (I do not take into account the other reference to γεγραμμέναι διαιρέσεις in *de Partibus Animalium* 642 b 12, as nothing is said there to show that these have anything to do with Plato.) In *Epistle* xiii, which purports, as I believe with truth, to be written by Plato to Dionysius II soon after his return from the Syracusan visit of 367–366, Plato says he is sending his correspondent certain 'divisions', (360 b 7 τῶν τε Πυθαγορείων πέμπω σοι καὶ τῶν διαιρέσεων). This has been understood (e. g. by E. Meyer *Geschichte des Altertums* v. 507) to refer to the διαιρέσεις mentioned by Aristotle and both passages to allude to the *Sophistes* and *Politicus*. Though E. Meyer introduces these identifications with a *bekanntlich*, they seem to me wholly arbitrary. There is nothing in the language of *Ep.* xiii to justify the assumption that the 'divisions' sent to Dionysius were a Platonic

dialogue, or even that Plato was their author. From the way in which they are coupled with Πυθαγόρεια one would rather infer that he was not. In any case it is not likely that a dialogue or dialogues are meant. It is much more likely that the reference is to standard or sample 'divisions' used in the Academy but *not* circulated. We know not only from the *Sophistes* and *Politicus* but from the derisory allusions of contemporary comic poets collected in Diogenes Laertius's *Life* of Plato (D. L. iii. 26-8) and elsewhere that the classification of plants and animals was minutely studied by Plato and his scholars, and the *Sophistes* and *Politicus* provide us with half-playful illustrations of the method employed. It was used also in quite different departments of knowledge. The formal object of the Tenth Book of Euclid, which is known to be based on the work of the Academy (Scholia in Euclid, ap. Heiberg, vol. v, p. 450, Zeuthen *Histoire des Mathématiques*, p. 130) is to make a systematic classification of the different types of quadratic surds. The regular pursuit of such inquiries almost necessarily presupposes the drawing up of standard 'divisions' as models of the procedure. It is precisely out of such beginnings that the two great Platonic dialogues which deal with 'division' have grown, but it is quite a different matter to identify the dialogues with the standard divisions they presuppose. Again there is no sufficient reason to identify the 'divisions' sent to Dionysius with those mentioned by Aristotle in the *de Generatione*. All that we can infer from Aristotle's reference is that he knew of some 'division' employed by Plato in which the sensible components of bodies were reckoned as three apparently, 'earth', 'fire', and an intermediate constituent which included both 'water' and 'air'—a classification, in fact, corresponding to our familiar distinction between the solid, liquid, and gaseous states. His words do not imply that he is referring to anything in Plato's 'works', the nearest approach to a 'division' of the kind he mentions to be found in the dialogues is perhaps the passage at *Sophistes* 220 a, where birds and fish are classed together as creatures that swim in a fluid (*τὸ μὲν πεζοῦ γένους . . . πεζοθηρικόν, τὸ δ' ἕτερον νευστικοῦ ζῴου πᾶν ἐννγροθηρικόν*). I cannot believe that any one will suppose Aristotle's statement that Plato 'in the divisions' treated the forms of body as three to have been manufactured out of this classification of birds with fishes, and therefore I feel confident that the reference is not to anything in the dialogue at all. In the one other passage where Aristotle refers to such *διαιρέσεις* (*de Partibus*

Animal. A. 642^{b} 12, it is to complain that certain γεγραμμέναι διαιρέσεις make the mistake of putting some birds in the class of 'aquatic' creatures, and having no common class of *birds*. Now in *Sophistes* 220 b Plato does subdivide the hunting of aquatic creatures into two branches, the hunting of birds and the hunting of fish (ὀρνιθευτική and ἁλιευτική). So far, this might be what Aristotle is criticizing, if one supposes that his criticism is even more than usually carping. He would be unfairly commenting on Plato's 'division' as though it were meant, as it is not, for part of a zoological classification of vertebrata. But he does not say that he has Plato in mind, and, even if he has, I find it impossible to think that he would have referred to a 'published' dialogue by such a title as γεγραμμέναι διαιρέσεις. I think it much more natural to suppose that if he is alluding to Plato, the reference is to 'model' divisions used in the Academy, of which that employed in the *Sophistes* for the definition of the angler may very well have been one. In any case, there is manifestly no ground whatever for supposing that the 'divisions' sent to Dionysius were Platonic dialogues. *Ep.* xiii therefore throws no light on the date of composition of the *Sophistes*.[1]

It would follow from these considerations that we have for the

[1] Since these remarks were written I have had the opportunity of studying Mr. Joachim's views on the reference to the *de Generatione* in his note on the relevant passage. I find myself unable to accept his suggestion that the reference is to the *Timaeus* itself (35 a 1–36 b 6). I cannot believe that the ψυχογονία, the account of the structure of the soul of the οὐρανός, is likely ever to have been called 'the divisions' merely because Timaeus says that *when* the ingredients of the cosmic soul had been blended, the Creator went on to 'divide' the blend in certain proportions (ἤρχετο δὲ διαιρεῖν ὧδε, 35 b 4), nor yet that if this part of the *Timaeus* had been spoken of in Aristotle's day by such a name every trace of the fact should have perished before the age of 'commentators'. Moreover, since Aristotle is here coupling Plato with 'Parmenides' (i. e. the persons whose cosmology was given in Parmenides' 'Way of Opinion') on the ground that Plato makes the στοιχεῖα of *sensible bodies* three, one of which is a μίγμα, it is unlikely that he has the formation of the cosmic ψυχή in his mind. If the allusion is to anything in the dialogues, it seems to me that there are only two alternatives: (1) the meaning is that Plato, like 'Parmenides', actually makes fire and earth στοιχεῖα, but treats τὰ μεταξὺ τούτων, οἷον ἀέρα καὶ ὕδωρ as a μίγμα, just as 'Parmenides' is said to have treated them as μίγματα; in that case I think the reference must be to the passages cited in my text; (2) or it may merely be meant that Plato analyses the sensible world into three 'kinds' (not specified by Aristotle), and that one of them is a μίγμα of the other two. This would be a pretty clear allusion to the three γένη of *Philebus* 24–5 ἄπειρον, πέρας, τὸ μεικτὸν ἐκ τούτοιν ἀμφοῖν. On reflection I incline to think that this is probably what Aristotle is referring to. I have, however, left the other suggestion in the text, as one cannot be sure on such a point.

composition of the *Timaeus* a *terminus a quo*. We must think of it as written after 360 and probably not immediately after that date. The *terminus ad quem* will only be given by Plato's own death in the year 347–346. Or, allowing a couple of years or so for the *Sophistes* and *Politicus*, if the usual view about their place in the series is correct, we should have to think of Plato as writing our dialogue somewhere between the ages of sixty-five and eighty or eighty-one. I do not believe it possible at present to make any more precise statement. We have really no means e. g. of deciding whether the *Timaeus* is earlier or later than the *Philebus*.[1] Nor can we say much about the relation of either to the *Laws*, except that the *Laws*, which seems to have been originally inspired by the legislative projects on which Plato and Dionysius were engaged in Syracuse (*Ep.* iii. 316 a), and has plainly never received a final revision, presumably occupied the writer more or less continuously to the end of his life. Hence the rest of the 'later dialogues' must have been composed simultaneously with various parts of the *Laws*. Possibly stylometric methods and the study of the rhythms of the *clausulae* may hereafter make it possible to indicate which parts of the *Laws* are most nearly contemporary with a particular dialogue, but even if this should some day be possible, we must remember that it would be highly unsafe to assume that the *Laws* themselves must have been composed in the order in which their

[1] There is one consideration which may take us a little further. In the notes on the medical section of the dialogue I have offered reasons for thinking that Plato probably derived his knowledge of the medical doctrines current at Locri from the physician Philistion, a citizen of that town. Philistion is mentioned only in one passage in Plato (*Ep.* ii. 314 e). We learn there that at the time of the letter Philistion was in Syracuse, apparently in medical attendance on Dionysius II. Now *Ep.* ii is pretty clearly a letter written from Athens after Plato's *second* visit to Dionysius in the years 361–360, since it presupposes that Dionysius is deeply engrossed in his mathematical studies (312 d 2 ff.), and it seems plain from *Ep.* iii that these were only taken up in downright earnest in connexion with this second visit (*op. cit.* 319 a–d). Presumably then, it was in 361–360 that Plato's own personal intercourse with Philistion fell. If so, it is reasonable to suppose that the *Timaeus* was composed while Plato's mind was still full of the subjects which he had been discussing with Philistion, and its date is likely to be nearer to 360 than to 347–346. Probably, then, not only much of the *Laws* but the *Philebus* will be later work than our dialogue. If we could connect *Ep.* ii with the visit to Syracuse in 367, we should be justified in putting the dialogue earlier. But this is less likely, since *Ep.* ii speaks of Polyxenus, who is introduced to Dionysius in *Ep.* xiii, as now resident in Syracuse. Thus I agree with Baeumker (*Problem der Materie in der griechischen Philosophie* 130 n. 2) and Robin (*La Place de la Physique dans la Philosophie de Platon* 10 n. 2) in regarding the *Philebus* as probably a later dialogue than the *Timaeus*.

parts were meant to be read. The actual 'legislation' of the later books is likely to be largely earlier in date of composition than the more general moral, social, and political theory which stands as an introduction to it in Bks. i–iv. (This is borne out by the fact that at *Laws* i. 638 b there seems to be an allusion to the victory of Dionysius II over Locri in the year 356.)

One very important consequence follows at once from these considerations. As we shall have occasion to see, there are some points of vital importance on which the astronomy of the *Laws* differs from the scheme expounded by Timaeus. Those who have not been content to shut their eyes to the disagreement have hitherto usually explained it by supposing that Plato changed his mind between writing the *Timaeus* and writing the *Laws*. But it seems to be clear for reasons already given that we are not entitled to say with any confidence that the astronomical passages of the *Laws* were written later than those of the *Timaeus*. Even if they were, there is not likely to have been any very long interval of time. Now Aristotle was vehemently opposed to any astronomical theory which presupposed (as I intend to show, in the proper place, that both the theory of Timaeus and the theory of the *Laws* do) a proper motion of the earth. If Plato had put forward two quite inconsistent theories about this motion within a few years of one another, I cannot believe that Aristotle, when discussing the subject in *de Caelo* B. 13, would not have fastened at once on such a chance of discrediting the whole doctrine. (Since he was a member of the Academy from 367 onward, he could not have been ignorant of such a *volte-face* if it had ever occurred.) But Aristotle never indicates by the slightest hint that Plato had taught two incompatible doctrines within a few years. This ought to suggest that Plato is not giving the astronomy or the other theories of Timaeus as his own at all. We must remember that the speaker who expounds the cosmology of the dialogue is not Plato but a Pythagorean of the fifth century, a man, as I propose to prove, in all probability from twenty to twenty-five years older than Socrates, and a contemporary of Zeno and Empedocles. I shall also show directly that he is supposed to be speaking at a time when Plato was quite a small child, if not a mere infant. It is likely then that the theories put into his mouth only represent such an approximation to what Plato regarded as true as might reasonably be ascribed to a contemporary of Empedocles. In some matters we can see at once for ourselves that Plato is making Timaeus speak 'in

character'. For example, he speaks of mist and 'darkness' as forms of 'air',[1] though it is incredible that Plato himself ever fell into this confusion of atmospheric air (which Empedocles and Anaxagoras proved experimentally to be a real, though invisible, body) with mist or cloud. Why, then, should we take it for granted that Plato himself ever held the peculiar planetary theory he ascribes to his Pythagorean? I propose to discuss this question in detail in connexion with the specific passages of the text. It is, in fact, the main thesis of the present interpretation of Plato's dialogue that the teaching of Timaeus can be shown to be in detail exactly what we should expect in a fifth-century Italian Pythagorean who was also a medical man, that it is, in fact, a deliberate attempt to amalgamate Pythagorean religion and mathematics with Empedoclean biology, and thus correctly represents the same tendency in fifth-century thought for which the name, e.g. of Philolaus stands in the history of philosophy. (See *EGPh.*[3] pp. 278-9, 292, 295-6.)

If this view is sound, it follows that it is a mistake to look in the *Timaeus* for any revelation of the distinctively Platonic doctrines, the ἴδια Πλάτωνος as Aristotle calls them (*Met.* A. 987[a] 31), by which Platonism is discriminated from Pythagoreanism, or for a 'later Platonic theory' which can be set in opposition to the type of doctrine expounded in the *Phaedo*. I shall set myself in commenting on the relevant passages to argue in detail that we do not, in fact, find any of the doctrines Aristotle thought distinctive of Plato taught in the *Timaeus* or in any other dialogue. But on the other hand, what the *Timaeus* loses, if my view is a sound one, as an exposition of Platonism, it gains as a source of light on fifth-century Pythagoreanism. If I am interpreting it on right lines, it is incomparably the most important document we possess for the history of early Greek scientific thought. Naturally, I cannot present the case for such an exegesis in a summary and preliminary way in an *Introduction*. The case for it is its success or failure when applied to the whole detail of the dialogue, and can be presented in nothing more compendious than this commentary as a whole. For the present I wish merely to point out an antecedent possibility which the editors of the dialogue and nearly all the historians of Greek philosophy seem to have ignored, and to urge that it is high time to take account of

[1] *Tim.* 58 d 1 ἀέρος, τὸ μὲν εὐαγέστατον ἐπίκλην αἰθὴρ καλούμενος, ὁ δὲ θολερώτατος ὁμίχλη τε καὶ σκότος.

it by the experiment of interpreting the *Timaeus* on the lines I have indicated. If the experiment succeeds, it will make a great deal of difference to our views on the early history of several sciences, notably astronomy. If it fails it will have *proved* what has in the main until lately been merely taken for granted by most students of Plato. At present I will only add that it is no evidence of the falsity of my proposed method of interpretation that Aristotle sometimes speaks of the statements of the dialogue as those of 'Plato'. That is, in any case, as natural as our own way of quoting the reflections of Hamlet as 'Shakespeare's'.

I should like to subjoin at this point one general reflection which I believe to be of importance. The attempt is often made to discredit interpretations of Plato's philosophy on the ground that they are at variance with 'tradition', the tradition in question meaning that of the majority of nineteenth-century expositors and not going back beyond the age of Hegel and Schleiermacher. As an apology for being so often constrained to differ from scholars with whose learning I am only too well aware my own small stock of knowledge cannot be compared, I would urge that a tradition which only goes back to the year A.D. 1800 has no claim to authority. What it is vital to the student to know is not what Hegel or Schleiermacher supposed Plato to mean, but what the men who had heard his doctrines from his own lips or from those of his immediate disciples supposed him to mean. What did Aristotle and Theophrastus, Speusippus, Xenocrates, and Crantor suppose to be the Platonic philosophy? It is an almost equally important question what Plato was taken to mean at a later time by men of real learning to whom the work of his immediate successors was accessible. What did Posidonius or Plutarch or Atticus take him to mean? How was he understood, even later, by men versed in the earlier literature like Plotinus and Proclus? We may be able to prove that on various points the exegesis even of those of these men who had known Plato personally can hardly be correct, but our very first step towards a really historical explanation of his works ought to be the careful recovery of this continuous tradition, wherever it is still possible to recover it. Great learning and ingenuity are only too likely to be merely thrown away if we forget always to reckon with the Academic tradition wherever it can be traced with any confidence. Unfortunately, too few of the interpreters of Plato in the past hundred years seem to have been alive to this obvious consideration, though the right way of investi-

gation has been illustrated, e. g. in Professor's Burnet's *Greek Philosophy: Thales to Plato*, and on a monumental scale in Professor Robin's work *La Théorie Platonicienne des Idées et des Nombres d'après Aristote*. If the present commentary should be found to shed any real light on the *Timaeus*, I believe it will be because the first question the writer has asked himself on every point has been whether it can be ascertained what Aristotle and his Academic contemporaries took to be Plato's sense, and the second what was supposed to be the sense by the long chain of Platonic commentators down to Proclus. *Claudus in via antevertit cursorem extra viam.*

C. GENERAL PLAN OF THE DIALOGUE

The *Timaeus* announces itself as one of a group of connected discourses. The assumed situation is that Socrates on the preceding day has related to Timaeus, Critias, Hermocrates, and a fourth unnamed person, who is at present confined to the house by indisposition, the conversation which he had held the day before in the house of Polemarchus with Thrasymachus, Glaucon, and Adimantus. Thus the *Timaeus* is dated two days after the *Republic*, and it is now assumed that the words 'Yesterday I walked down to the Piraeus', &c., were spoken to Critias and his guests.

It is now the turn of Socrates to listen. After reminding his hearers of the main heads of his recent discourse, he remarks that he would be glad to see a picture of a community like his ideal state actually performing some great feat of war or peace. He cannot make such a picture for himself as he has not the art of putting life into the figures. To do that, a man must be at home in affairs as well as in philosophy. Socrates has the second qualification but not the first. He has no experience of public life and cannot make a story of political achievement with true dramatic life about it. Timaeus and Critias, however, have behind them a record of eminence both in science and in action, and those who know Hermocrates vouch for it that he too has abilities which promise great things in both fields. So Socrates appeals to his friends to help him out. They tell him that they have already agreed on a programme. Critias is in possession of a family tradition derived from Solon, who had learned it in Egypt, that 9,000 years ago Attica enjoyed the very institutions described in *Republic* i–v. The citizens of this ideal prehistoric Athens were attacked by the enormous forces of the federated kings of Atlantis,

an island lying just outside the Straits of Gibraltar. These kings were bent on the conquest of the world and had so far met with no check, but Athens 'saved herself by her exertions and the rest of the world by her example'. Afterwards, in one awful day and night of storm and earthquake, the Athenian warriors were swallowed up by the soil and Atlantis settled down under the waves of the ocean which bears its name. The three friends have arranged that to-day Timaeus shall describe the making of the world by God, ending with the creation of man. To-morrow Critias will tell the full story of the heroic exploit of Athens. What Hermocrates was to take as his theme (supposing that he was to speak at all, as is not certain) we are not told. In fact Plato has left the narrative of Critias a mere torso of a few pages, and apparently never drafted any part of the discourse of Hermocrates.

It is very important to note the assumed date of this meeting and the period of Socrates' life to which it belongs. From the contrast between the language employed about the achievements of Timaeus and Critias (20 a 1 ff.), and in introducing Hermocrates, we see that this last is a young man who has as yet achieved nothing very notable, though those who know what his parts are and what his education has been have high expectations from him. Hermocrates is sufficiently shown, by his being a fellow-guest of Critias with the Italian statesman and philosopher Timaeus, to be the famous Syracusan who figures so prominently in Thucydides' narrative of the disastrous Sicilian adventure of the Athenian δῆμος in 415–413 B.C. He appears to have first come into prominence some eight years earlier by advocating at the Pan-Sicilian Congress of Gela a sort of 'Monroe doctrine', according to which Sicilian affairs were to be regarded as wholly disconnected from the politics of Eastern Hellas[1] (Bury *History of Greece*[1], 465). It is obvious that the meeting of Timaeus and Hermocrates with Socrates is supposed to take place at any rate several years before 415. Even at the opening of the Athenian campaign against Syracuse, Hermocrates was no unproved youth but a man of established reputation. Thucydides (vi. 72) expressly calls him *ἀνὴρ καὶ ἐς τἆλλα ξύνεσιν οὐδενὸς λειπόμενος καὶ κατὰ τὸν πόλεμον ἐμπειρίᾳ τε ἱκανὸς γενόμενος καὶ ἀνδρείᾳ ἐπιφανής*. It is also clear from his

[1] See Thucydides iv. 58 (under the events of the year 424) *τοῦ δ' αὐτοῦ θέρους . . . οἱ ἄλλοι Σικελιῶται ξυνελθόντες ἐς Γέλαν, ἀπὸ πασῶν τῶν πόλεων πρέσβεις, ἐς λόγους κατέστησαν ἀλλήλοις . . . καὶ Ἑρμοκράτης ὁ Ἕρμωνος Συρακόσιος, ὅσπερ καὶ ἔπεισε μάλιστα αὐτούς, ἐς τὸ κοινὸν τοιούτους δὴ λόγους εἶπεν.*

presence with Timaeus as an honoured guest at Athens that the relations between Athens and the cities of Locri and Syracuse are supposed to be peaceful and friendly. We cannot well place the supposed date of the encounter later than some time during the 'peace of Nicias', and it would suit the supposed situation to date it, if anything, even earlier. We may take some time not later than 421 B.C. as the date suggested by what we are told of Hermocrates and by his very presence in Athens. The rival theory that the visit to Athens is supposed to fall after the failure of the Syracusan expedition in that banishment of Hermocrates which is mentioned by Xenophon (*Hellenica* i. 1. 27, 3. 13) is merely preposterous. The man who had been the heart and soul of the Syracusan defence against the great Athenian Armada could not have been spoken of as Socrates speaks of Hermocrates in our dialogue, nor could Athens, whose generals had been executed by the triumphant Syracusans (though it is said against the wishes of Hermocrates), and which was now engaged in the Decelean war, have been a comfortable, or even a safe, place for Hermocrates to visit. The earlier date also fits in, as the later does not, with the fiction that the conversation followed on that reported in the *Republic* with an interval of only one day. In the *Republic* the orator Lysias and his brother Polemarchus are *νεανίσκω*, the former too young to take any part in the conversation, and their father Cephalus is, though very old, still alive. In other words, the conversation is supposed to be held before the departure of Polemarchus and Lysias to Thurii. They returned to Athens, after many years residence at Thurii (*Vit. Lysiae* 1) in the year of Callias (412–411). The meeting described in the *Republic* is thus long anterior to the date just mentioned. Plato's two brothers, Adimantus and Glaucon, are mentioned as having distinguished themselves in a battle near Megara, which can hardly be any but that of the year 424 (Thucydides iv. 72). Thrasymachus, too, is assumed to be at the very height of his fame, and we may infer from the fragments of Aristophanes' Δαιταλῆς that he was already a prominent figure at Athens as early as 427.[1] Similarly, Damon, or Damonides of Oea, already mentioned by Isocrates along with Anaxagoras as one of the two 'sophists' who 'educated' Pericles, is assumed in *Republic* iii to be living at Athens. This means that

[1] Aristoph. *Fr.* 198, 8 *οἴμ', ὦ Θρασύμαχε κτλ.* Whether the word is here used as a *p. n.* or as an epithet, the allusion seems certain.

he had already returned from his ostracism, the date of which seems unknown. But a man who could be supposed to have 'educated' Pericles must, like Anaxagoras, have been born about 500, at the latest, and consequently must have been in extreme old age at any date as late as 420. It fits in with this that though Damon is spoken of as still living in the *Laches*, where Nicias expresses his gratitude to Socrates for introducing his son to such a man, the younger general Laches is said to have no acquaintance with him. Damon is supposed to be a very old man living in complete retirement. (The date of the *Laches* is supposed to be after, but clearly not long after, the battle of Delium in 424.) The opening conversation of Socrates with Cephalus is further quite pointless unless Socrates is supposed to be still in the full vigour of manhood with a good term of years to live before he will be getting to the age at which a man is a γέρων, an age officially fixed at Athens as one's sixtieth year. We clearly must not think of him as more than fifty, and should probably think of him as a little younger.

Thus the *Republic*, no less than the *Timaeus*, presupposes a date not later than about the time of the peace of Nicias (421 B.C.). Indeed a date two or three years earlier would suit both dialogues better rather than worse, but for one consideration. As Professor Burnet has pointed out to me, both dialogues seem to presuppose a state of peace. Socrates, Glaucon, Adimantus are all at home, and there is no explanation of the fact supplied, nor any hint that their city is engaged in warlike operations. The years just before the conclusion of the peace were those of the meteoric career of Brasidas, and were marked by serious reverses for Athens in the northern regions which it was for commercial reasons so necessary for her to control, in particular by the loss of her important foundation of Amphipolis. Hence the complete absence of any allusion to a state of war seems to make it hard to date the *Republic* (and by consequence the *Timaeus*) in the closing years of the Archidamian war. Indeed, Socrates himself was serving at Delium in 424 and before Amphipolis in 422 (?). It is conceivable that both he and the two young men were not on service in the intermediate year 423, and the selection of him as a butt by the comedians in that year makes it more probable than not that this was his own case. We thus have to choose, if we are to trust Plato's indications, between 423 and the opening years of the peace, and the tone of our two dialogues makes the later date on the whole the more plausible. We shall thus not go far wrong if we fix on

421 B.C. as the probable year in which we are to imagine Socrates as meeting Timaeus and Hermocrates.[1]

Some important results follow at once from this assumption. We are told of Timaeus that he has not only climbed to the 'top of the tree' in science, but has already filled the most important ἀρχαί in his native Locri. This means that he is quite an old man with a very distinguished career behind him. We cannot well imagine him to be less than seventy and he may be decidedly older. His birth will fall at latest somewhere about 490. This makes him roughly contemporary with Zeno of Elea, Empedocles, and Philolaus, and a little younger than Anaxagoras. As for the dates of these philosophers, we are told expressly by Plato (*Parm.* 127 b) that when Socrates as a 'very young man' met Parmenides and Zeno, Zeno was 'about 40'. This means that he was forty about the year 450, and so was born not long before 490. Anaxagoras, like Damon, 'educated' Pericles (Isocr. περὶ ἀντιδόσεως 235), and was said by Demetrius of Phalerum to have been twenty years old at the time of Xerxes' invasion of Greece. This puts his birth in or about 500 B.C. The one thing certain about Empedocles is that he was a few years younger than Anaxagoras (*EGPh.*[3] 198 n. 2). For Philolaus we have no certain date. But he had been at Thebes towards the end of the fifth century and had taught Cebes and Simmias, who are represented by Plato as quite young men (*Phaed.* 61 d–e). The unmistakable allusion to him at *Gorgias* 493 a seems to imply that he was considerably older than Socrates. Timaeus must thus be thought of as born at the very beginning of the fifth century. Plato does not mention that he was a Pythagorean, though no one has ever doubted the tradition, which is abundantly confirmed by the characte of the cosmology put into his mouth. In the catalogue of Pythagoreans given by Iamblichus (*Vit. Pyth.* 267) his name does not occur as a Locrian, but there is a Timaeus among the Parians, who are mentioned just before the Locrians, and it thus seems probable, as Diels has suggested (*Frag. d. Vors.*[3] i. 345), that the name has got into the wrong line.

[1] Even so, it is remarkable that Socrates should speak of the man who had already played the leading part at Gela in 424 as a person of *promise*. But Athenians in 421 may very well have not been particularly informed about what had happened three years before at Gela. From the standpoint of a home-keeping Athenian like Socrates, Hermocrates might well be an 'unknown quantity'. Since Plato had pretty certainly read his Thucydides, Socrates' manifest ignorance of the part Hermocrates had already taken in the public life of Sicily may be a conscious touch of correct historical colouring.

The dates must be carefully kept in mind in reading the dialogue. Timaeus would hardly be an immediate disciple of Pythagoras, but he must have been a follower of others who had been immediate disciples. This will explain why there are so many traces in his doctrine of ideas which obviously belong to the earliest days of the school or even go back to the Milesian cosmogonies of Anaximander and Anaximenes from which Pythagoras evidently started, as was natural in a sixth-century Ionian (see *EGPh.*[3] 108–10). The connexion with Empedocles and Philolaus, which is explained by the fact that Timaeus was their contemporary and came from the same part of the world, is even more significant. Empedocles was the real founder of the Sicilian school of medicine, and Philolaus, as we know from the statements about him in the fragments of the *Iatrica* of the Peripatetic Menon, was a member of this school. The special aim of the school, as Bt. has shown, was to work the Empedoclean theory of the 'four roots', or elementary bodies, into the Pythagorean system (*EGPh.*[3] 292–6). This is exactly what we shall find Timaeus trying to do in his famous geometrical construction of body (*Tim.* 53 c–55 c). It is another touch of historical plausibility that the main theories of sensation given by Timaeus are so closely akin to those we know to have been held by Empedocles, and again that his physiology is everywhere dominated by the double assumption that all organic tissues are compounds of the 'roots' (Empedocles), and that the differences between the 'roots' are themselves ultimately differences in the geometry of their corpuscles (Pythagoras). In fact, we might say that the formula for the physics and physiology of the dialogue is that it is an attempt to graft Empedoclean biology on the stock of Pythagorean mathematics. It is equally in keeping that where Timaeus disagrees with Empedoclean theory he appears to lay special emphasis on his divergences. And it is equally instructive to find that the fusion of Pythagoras and Empedocles does not permit of being completely carried out. Historically it was the Empedoclean influence that led to the development of doctrines like that of the soul as the 'attunement' (ἁρμονία) of the body, which are quite inconsistent with the fundamental presuppositions of the Pythagorean way of life. We shall see that this incongruity of the Empedoclean with the Pythagorean elements in his beliefs leads Timaeus himself into a variety of real inconsistencies which culminate in an absolutely unqualified contradiction between a medical or physiological 'determinism' (*Tim.*

86 b–87 b) and a religious and ethical doctrine of human 'freedom', agreeing precisely with the undoubtedly Pythagorean 'myth of Er' in the *Republic*. The very dramatic and historical rightness of all these touches should make us very slow in assuming that Plato meant to give out any of these theories as his own. Aristotle and Theophrastus criticize the theories of Timaeus on many points as 'Plato's', but that is, in any case, a natural way of speaking, and we must remember that Plato repeatedly warns us in this very dialogue that cosmology and physical science in general can never be more than 'provisional'. It is at best made up of tales 'like the truth'. Hence Plato was not likely to feel himself responsible for the details of any of his speaker's theories. All that is required by his own principles is that they shall be more or less 'like' the truth, i. e. that they shall be the best approximations to it which could be expected from a geometer-biologist of the fifth century. In other words, we are entitled to say that Plato thought the view which arose from the fusion of Pythagoras with Empedocles the most promising line in fifth-century science and the one most directly connected with his own developments. It does not follow that *any* theory propounded by Timaeus would have been accepted by Plato as it stands. The way in which Timaeus is made at each chief new step in his narrative to insist on the highly provisional character of his speculations is a most significant feature of the dialogue, to which no one as yet seems to have done full justice. What Plato himself really thought about a good deal of Empedocles has to be learned not from our dialogue but from *Laws* x, where Empedocles more than any one else is plainly aimed at in the exposure of the defects of 'naturalism'. As for Aristotle, the most significant peculiarity of his criticism is that he is so careful in discussing Timaeus's language about the motion of the earth never to ascribe it to Plato.

Another point which must not be overlooked is that Plato represents Socrates as deeply interested in the cosmological speculations of Timaeus and as recognized by Timaeus as sufficiently equipped with mathematics to follow them readily (*Tim.* 53 c 1 *ἀλλὰ γὰρ ἐπεὶ μετέχετε τῶν κατὰ παίδευσιν ὁδῶν δι' ὧν ἐνδείκνυσθαι τὰ λεγόμενα ἀνάγκη, συνέψεσθε*). It is often said that Socrates took no interest in such matters, at least not after the intellectual crisis of his early years described in the *Phaedo*. The evidence for this is supposed to be found in one single passage of Xenophon *Mem.* iv. 7. 1–6. Xenophon's testimony, however, really points

the other way, for what he actually says is that though Socrates was not himself 'unversed' in geometry (*οὐκ ἄπειρός γε αὐτῶν ἦν* loc. cit. 3), or astronomy (*οὐδὲ τούτων γε ἀνήκοος ἦν* ibid. 5), he told young men that there were more important things for them to know. Moreover, Xenophon's evidence can only be admitted for the period in which he knew Socrates personally, that is for Socrates' old age. But the *Timaeus* professes to depict Socrates as he was in the days when Xenophon, who cannot have been much more than twenty-five when he fought at Cunaxa, was little more than an infant. In fact, the supposed date of the *Timaeus* is within a year or two of the famous burlesque of Socrates by Aristophanes in the *Clouds* (423 B.C.). When we remember this, we ought to see that the picture drawn by Plato exactly fits in with the admirable caricature of Aristophanes.

We may even go further than this. There is a remarkable passage early in the *Memorabilia* which is all the more important that it is dangerously out of keeping with the tone of the work as a whole. Xenophon's main thesis is that Socrates was not a 'scientific' man, was no 'professional' educator and had no 'disciples'. He was simply an excellent man of deep moral earnestness who impressed on his young companions those moral lessons of 'practical' goodness which every decent parent wishes to impress on his own family, but much more effectively than the ordinary parent could hope to do. This is Xenophon's defence of Socrates against the charges brought against him by the 'accuser'. But in *Mem.* A there is a chapter about the relations of Socrates with the sophist Antiphon which is hopelessly inconsistent with all these assumptions. We are told there that Antiphon wished to steal the *συνουσιασταί* of Socrates from him (*Mem.* i. 6. 1). He argued that Socrates got no 'happiness' out of his *φιλοσοφία*, but lived a hard life only fit for a slave. Nor did he take any fee as 'teachers' may fairly expect to do from their 'disciples' (ibid. 3). Socrates replies that he lives hard by choice, and that his practice of taking no fee safeguards his spiritual independence. Antiphon then urges that the habit may be morally noble (*δίκαιον* loc. cit. 11), but is not 'wise'. If a man does not charge for his *συνουσίαι*, it looks as though he himself had no real belief in their value. Socrates makes the famous parallel between the venal beauty who sells his 'person', the *πόρνος*, and the venal 'sophist' who sells his knowledge, and goes on (loc. cit. 14) to explain the real nature of the occupations of himself and his circle.

'In the company of my friends I unroll and search the treasures of the wise men of old which they left behind in the scrolls they wrote (*τοὺς θησαυροὺς τῶν πάλαι σοφῶν ἀνδρῶν, οὓς ἐκεῖνοι κατέλιπον ἐν βιβλίοις γράψαντες*), and if we see a good thing we pick it out. And we count it great profit if we come to be friends to each other.' Thus Antiphon, though he knows that Socrates does not take money from his associates, assumes that his relation with them is that of a professional head of a school. This is why he uses the technical word *συνουσία*, *Stunde, conférence*, for Socrates' supposed discourses, and why his associates are called *συνουσιασταί* and *μαθηταί*.

Socrates' reply is meant to correct this assumption. His relations with his associates are non-professional; they are his *φίλοι*, not his *μαθηταί*. And they are not 'auditors' who get 'instruction' from him, but fellow-students. Clearly, the basis of the whole story is that Socrates' relations with his circle could be plausibly mistaken for those of an unpaid 'instructor', and Socrates himself says nothing inconsistent with the view that they are at any rate those of a 'director of studies'. Now we know enough from Plato alone of Socrates' avocations in the last twenty years of his life to be sure that at *that* time, the only time of which Xenophon could speak from his own knowledge, such a representation could not have been possible. It follows that the story about Antiphon is no reminiscence, or invention, of Xenophon himself. He must have got it from some older associate of Socrates, possibly Hermogenes, to whom he 'acknowledges a debt' at *Mem.* iv. 8. 4,[1] and its value is thus independent of our opinion of the veracity of Xenophon's personal recollections. That it is a genuine tradition of the way in which Socrates was looked upon at an earlier date is guaranteed by its inconsistency with the main thesis of

[1] Hermogenes was the brother of Callias, son of Hipponicus. Callias appears as intimate with Socrates in the *Protagoras*, a dialogue obviously laid in the years before the outbreak of the Archidamian War. (See e. g. my *Varia Socratica* p. 139.) Hermogenes himself figures in the *Cratylus*, and was also introduced, independently of Plato, in the *Telauges* of Aeschines of Sphettus. The dramatic date of the *Cratylus* is quite uncertain, but I would suggest that the allusion to fines imposed on persons who are abroad 'after curfew' in Aegina (*Crat.* 433 a 7) is most naturally understood of some regulation imposed by the Athenians who occupied the island at the beginning of the Archidamian War (431 B.C.). If this is so, the dialogue will belong to the early years of the Archidamian War. However that may be, the brother of Callias, who is one of the guests at the 'banquet' of 422 described by Xenophon, would be in a position to have recollections of Socrates going back to the year of the *Clouds*.

Xenophon's book and its exact agreement with what we learn from the *Clouds* of the general impression produced by Socrates in 423 B.C. We may thus take Aristophanes and Xenophon's unnamed informant as good evidence for the view that the position of Socrates twenty-five to twenty years before his death was really much more like that of a professional head of a scientific school than has usually been supposed. There were, indeed, according to the story in Xenophon, subtle differences, but the resemblance was what would strike the ordinary man. Plato's description of the attention and comprehension with which Socrates follows the speech of Timaeus, itself a scientific *συνουσία*, fits exactly into this picture. No one, so far as I know, has yet seen that the *Timaeus* and the *Clouds* deal with the same period of Socrates' life, but the fact is really undeniable. When we recognize it we are beginning to be in a position to appreciate the consummate art which Aristophanes himself expressly attributes to this particular comedy.

We have to think of the Socrates of our dialogue, then, as a man of just under fifty. At that age Socrates was already known in certain high circles as a man whose advice to the young about their studies was very valuable. We read in Plato's *Charmides* of his first real introduction to the hero, Plato's own uncle, just after Socrates' return from the campaign of 431 before Potidaea, and he is represented as being even then keenly interested in young men of promise (*Charm.* 153 d). The connexion with Alcibiades goes back still further. It is represented as notorious in the *Protagoras*, which must be supposed to depict a state of things earlier than the outbreak of the Archidamian War, since in the dialogue Alcibiades, who fought in the cavalry at Potidaea, is described as only just beginning to show signs of physical manhood (*Protag.* 309 a). (In fact we learn from the *Symposium* (217 a) that this particular friendship went back to Alcibiades' early boyhood.) But from the *Laches*, which describes the conduct of Socrates in the retreat from Delium (424 B.C.) in a way which implies that it was still recent, we gather that the great vogue of Socrates with the *νέοι* at large was only beginning. For Lysimachus, an old friend of Socrates' father, says there (180 e) that he has often heard his boys talking with enthusiasm about a certain Socrates, but has only just discovered that their hero is the son of his old family friend. We may further infer that the public fame of Socrates as a mentor of the young was a new thing in 423 from the fact that both Aristophanes (in the *Clouds*) and Amipsias (in the

Connus) made him the subject of their plays of that year. His general notoriety must have been a recent thing to make it the natural object of these topical burlesques. We have no right to read into the *Timaeus* ideas about Socrates' interests and occupations derived from the *Apology* or from a dialogue like the *Gorgias* which represents him as he was fifteen years later, or from Xenophon, whose personal knowledge of Socrates must have been confined to a few years of the philosopher's old age.

It is even more important to note that Critias cannot be, as is generally assumed, that Critias who was cousin to Plato's mother and led the extreme party in the anti-democratic reaction of 404–403, or at any rate was one of its leading men. At the time of the peace of Nicias this Critias must have been a very young man who had as yet played no part in public life. In fact, we first hear of him in politics in the year 411. But *our* Critias is obviously a very old man with a distinguished past behind him. Socrates says (*Tim.* 20 a) that every one at Athens knows that Critias is no 'amateur' either in science or in politics. We are further told by Critias himself that Solon's poems were a 'novelty' when he was a boy of ten (*Tim.* 21 b 5), and it is implied that he is extremely old when he says (*Tim.* 26 b) that, though he recollects his childhood so vividly, he can hardly remember what he was told yesterday, and moralizes on the durability of 'early impressions'. There would be nothing *θαυμαστόν* in the fact that Critias *ὁ τῶν τριάκοντα*, who can hardly have been more than fifty when he was killed in 403, and would thus be about thirty-two at the time of our dialogue, should remember *his* boyish days. Bt. is thus clearly right in saying that the person meant must be Plato's own great-grandfather, the grandfather of the so-called 'oligarch'. This fits in with the genealogical facts mentioned. *Our* Critias speaks of his grandfather, also called Critias, as a son of Dropides, a friend and connexion of Solon. If the speaker were the 'oligarch', we should have to suppose that he has left out two generations of his own ancestors! (See the family tree at the end of *Greek Philosophy: Thales to Plato.*)

Even as it is, we have to suppose that this Critias is a remarkably old man. If we suppose him to be a little over ninety his tenth birthday would fall after 510 B.C., when Solon had been dead some half-century and more. That the poems of Solon could be a 'novelty' in 510 can hardly be explained except by recollecting that that is the time of the expulsion of the Pisistratidae from

Athens. Under Pisistratus and his sons the circulation of Solon's poems is not likely to have been encouraged; they would be likely to emerge from obscurity and to be temporarily very popular when the 'tyrants' were being expelled. Thus the remark about their 'novelty' in the childhood of Critias may be a peculiarly happy and delicate touch. Not much is known of this Critias, but chronology makes it probable that a fragment of a poem by one Critias in praise of Anacreon, who was famous at the end of the sixth century, is his, and it may be, as Bt. has suggested, that he is the real author of many of the elegiac verses which are traditionally assigned to his grandson, the 'oligarch'. The diction of classical elegy is so stereotyped that the language of the verses affords no criterion. Aristotle also mentions a Critias who adopted the theory of Empedocles that our blood is 'what we think with' (*de Anima* A. 405^{b} 6). This is usually supposed to be the 'oligarch', but the supposition is very unlikely. Biological speculations of this kind had lost their interest in *his* youth. Plato in the *Phaedo* 96 b mentions this very theory, along with others of the kind, as one over which the youthful Socrates had puzzled. That is, it was a 'live' issue about the middle of the fifth century. In the youth of the 'oligarch' the fashionable problems would rather be those started by Protagoras or even Socrates, 'Is science possible?' 'Are moral distinctions natural or conventional?' 'Can virtue be taught?' 'Are all the virtues one thing?' Hence I feel pretty certain that Aristotle means our Critias. If he was connected with Sicilian and Italian Pythagoreans, as the host of Timaeus may be supposed to have been, he would naturally be interested in Empedocles and his biology.

There is another passage of Aristotle which seems to me to refer to the same man. Unfortunately it appears to be textually imperfect. At *Rhetoric* Γ. 1416^{b} 26–9 Aristotle remarks that in an eulogy on Achilles there is no need to insert a narrative of his exploits because they are known to every one. But it would be different if one were eulogizing Critias. You would have to tell the story of his deeds because it is not generally known. (διὸ οἱ πολλοὶ οὐδὲν δέονται διηγήσεως, οἷον εἰ θέλεις Ἀχιλλέα ἐπαινεῖν· ἴσασι γὰρ πάντες τὰς πράξεις, ἀλλὰ χρῆσθαι αὐταῖς δεῖ. ἐὰν δὲ Κριτίαν, δεῖ· οὐ γὰρ πολλοὶ ἴσασι.) This can hardly refer to the 'oligarch'. It is not likely that any one in Aristotle's day would want to eulogize him, and it is not true that οἱ πολλοὶ did not know what his πράξεις were. Every one knew them only too well. Hence I suspect not only

that Aristotle has *our* Critias in his mind, but that he is alluding to the very words of Socrates about him in *Tim.* 20 a. I think he means that Plato has shown judgement in confining himself to the mere remark that 'every one of us knows that Critias is no amateur'. Since his precise achievements were no longer familiar to the generation for whom the *Timaeus* was written, any further eulogy would have required a long prefatory narrative of the facts, and this would have been a superfluous digression. It should be mentioned that Alexander of Aphrodisias was still aware that the reference in the *de Anima* was not to the 'oligarch'. Philoponus has preserved his remark that 'the Critias who belonged to the Thirty wrote nothing except *Constitutions* in verse' (cf. Diels *Fr. d. Vors.*[3] II. i. 312).

It is not very profitable to speculate on the identity of the unnamed person who was kept indoors by an ailment. We may be sure that he is meant to be a representative of the type of doctrine current in Sicily and Italy, since Timaeus agrees to take his place (*Tim.* 17 b). If any one in particular is meant it might be, as Bt. has suggested, Philolaus, who tried to combine Pythagoreanism with medical theories based on Empedocles, as Timaeus also does. We might even think of Empedocles himself, if it were not on the whole likely that he was no longer alive in 421. We have seen that he was probably born not many years after 500, and Aristotle appears to have said (see *EGPh.*[3] 198 n. 1) that he died at the age of sixty. The idea started in antiquity by Dercylidas that Plato himself is meant, though it has sometimes been revived in modern times, is merely ridiculous. It is based on the fact that Plato's absence from the death-scene of Socrates is ascribed also to ill-health at *Phaedo* 59 b, and on nothing more. But Plato would be a small boy of six or seven at the date of the present conversation. Still more ridiculous was the guess of Aristocles the Peripatetic that the absentee is Theaetetus, who was a mere lad at the time of Socrates' death in 399. Proclus shows his usual common sense in rejecting these and other guesses.

The question might occur why Timaeus, Hermocrates, and the unnamed third Italian or Sicilian should be present at Athens at all. We are hardly justified in assuming that they are there without a definite purpose. Perhaps our conclusion about the imaginary date of the dialogue throws some light on the point. Timaeus, we are told, had filled the highest public offices at Locri, and Hermocrates is expected to rise to eminence in politics as well

as in science. The guests of Critias are thus men of eminence in their respective cities. It is likely, therefore, that they are in Athens on matters of public business, and the presence of such a deputation would be a natural consequence of the resumption of diplomatic relations consequent on the recent general pacification. The Athenians had been showing an interest in Sicilian concerns ever since the year 427, and had been brought into close political contact with Italy even earlier by the foundation of Thurii in 444. In 422, the year before the pacification, Phaeax and his colleagues had been sent on a diplomatic mission to the Italian and Sicilian cities, the main object being to form a coalition against the ambitions of Syracuse, and one of the results of this expedition had been a proposal from Locri for a treaty with Athens (Thucydides v. 4–5). This may perhaps give us a clue to the presence of eminent Locrians and Sicilians in Athens in the following year and serve as a further confirmation of our view about the date to be assigned to the dialogue. The proposals for a treaty with Locri will account for the visit of Timaeus; as the original aim of the Athenians had been to create a check on Syracuse, we can also understand why the rising men in Syracusan politics should be on the spot as well. It is really unnecessary to consider the possibility that the Hermocrates of our dialogue is any other 'person of the same name'. Xenophon (*Mem.* i. 2. 48), according to the MSS., mentions an Hermocrates along with Chaerephon and his brother Chaerecrates and immediately before the Thebans, Simmias, Cebes, and Phaedondas as an ὁμιλητής of Socrates. This cannot mean the famous Syracusan, unless Xenophon, as is just possible, is making a false inference from the *Timaeus* itself. The list of ὁμιληταί is meant as one of 'habitual associates' who enjoyed the society of Socrates continuously, as Xenophon says, with a view to the perfecting of their personal character (συνῆσαν . . . ἵνα καλοί τε κἀγαθοὶ γενόμενοι καὶ οἴκῳ καὶ οἰκέταις καὶ οἰκείοις καὶ φίλοις καὶ πόλει καὶ πολίταις δύναιντο καλῶς χρῆσθαι). The known facts about the career of Hermocrates son of Hermon are hardly consistent with this prolonged frequentation of Socrates' society, and the way in which Socrates speaks of the opinions entertained of him by 'those who know about his φύσις and τροφή' show that he is a stranger to Athens. The place occupied by Hermocrates in Xenophon's list suggests that *he* is probably an Athenian like Chaerephon and Chaerecrates. As we know of no such person among the members of the Socratic circle, I feel fairly sure that Van Prinsterer was

right in substituting the name of Hermogenes, the brother of the 'millionaire' Callias, to whom Xenophon expresses obligations in the *Memorabilia*. Xenophon could hardly have omitted the name of one of his own informants from the list of Socrates' 'intimates'. In any case, if there was an obscure Athenian Hermocrates among the friends of Socrates, he cannot be the person intended in the *Timaeus*, who is manifestly a 'distinguished stranger' entertained as such (*Tim.* 20 c παρὰ Κριτίαν πρὸς τὸν ξενῶνα οὗ καὶ καταλύομεν) by Critias.

D. RELATIONS TO OTHER DIALOGUES

The one point on which something must be said under this head in this *Introduction* is the connexion between the *Timaeus* and the *Republic* and *Phaedo*. It is notable that when Socrates recapitulates his discourse of the day before, the survey takes in the matter of *Rep.* ii–v (the institution of the 'guardians' and 'auxiliaries', their early training, the abolition for them of private property and households, the ordering of their 'marriages' on eugenic lines and the introduction of women into the public services), but says nothing at all about the account of the scientific education of the philosopher-kings (vi–vii), the very part of the *Republic* we find most interesting.

This silence must be intentional, and we are bound to ask what its point is. According to the theory of the Platonic philosophy developed by Dr. Henry Jackson in his well-known series of essays on *Plato's Later Theory of Ideas* (*Journal of Philology* vols. x–xii), and repeated less cautiously in the *Introduction* of R. D. Archer-Hind to his edition of the *Timaeus*, the reason is that *Rep.* vi–vii teaches a metaphysical doctrine about the 'Ideas' or 'Forms' (ἰδέαι, εἴδη) which Plato afterwards abandoned. In the *Republic* and *Phaedo* (the chief of the *earlier* dialogues in which the Forms are spoken of) we always hear that the Forms are 'in' or 'present to' the things our senses perceive; these things 'partake' (μετέχει) of them. In the *Parmenides* this doctrine is subjected to what at first looks like a crushing refutation by the Eleatic philosopher Parmenides,[1] and in the *Timaeus* we never hear of 'participation'

[1] But see with reference to the real scope of these arguments *Greek Philosophy: Thales to Plato* pp. 253–63, and an essay by the present writer entitled 'Parmenides, Zeno, and Socrates' in *Proceedings of the Aristotelian Society*, N.S., vol. xvi, pp. 234–89.

(*μέθεξις*) of things in Forms. We are told that the Forms are 'patterns' or 'models' (*παραδείγματα*) which things 'imitate' (*μιμεῖται*). Hence Dr. Jackson and Mr. Archer-Hind infer that Plato began by teaching that Forms are 'immanent in' the sensible things which 'partake of' them. In later life he came to see grave objections to this doctrine, the same objections which he has put into the mouth of Parmenides. He now taught, therefore, that things are 'copies' of Forms which are not *in* them but 'outside' them and transcend them. The *Parmenides* is the literary record of this radical change of view, and in all the later dialogues from the *Sophistes* to the *Philebus* and *Timaeus* it is the 'later' form of the 'Ideal Theory' that confronts us. It is this 'later theory' which Aristotle has in mind when he finds fault with Plato, as he often does, for saying that the Forms are 'separate' or 'separable' (*χωρίς, χωριστά*) from sensible things, and the *Timaeus* is the one dialogue in which this 'later doctrine of Ideas' is fully expounded. It is also the doctrine which, as we learn from Aristotle, Plato expounded in his oral teaching in the Academy.

Now it is quite undeniable that there is a very real difference between the doctrine taught by Socrates in the *Phaedo* and *Republic* and that which Aristotle learned in the Academy and always refers to simply as the theory of Plato. But it does not follow that this last is taught in the *Timaeus*, and I do not myself believe that it is. At the most there are only one or two ambiguous hints which *might* cover an allusion to it. Nor again should we assume without inquiry that the doctrine of the *Phaedo* and *Republic* was ever taught by Plato as his own. Plato gives it ostensibly as the doctrine of Socrates and a group of his associates, and we have no right to assume without proof that this representation is not historically true.[1] In the *Phaedo* (99 d ff.) Socrates is made to say that he thought of it in his early life, and it is assumed to be familiar to the whole circle of intimates who are gathered round Socrates on the last day of his life. In the *Parmenides* Socrates, whose extreme youth is insisted on (*σφόδρα νέον* 127 c 5) explains the same theory to Parmenides and Zeno, and is at once asked whether he had thought of it *αὐτός*, 'unassisted', 'out of his own head' (*αὐτὸς σὺ οὕτω διῄρησαι ὡς λέγεις* 130 b 2). Proclus[2] rightly

[1] With what follows compare *Greek Philosophy: Thales to Plato* pp. 154-70 and the *Introduction* to Bt.'s edition of the *Phaedo* pp. xxxvii-xlv.

[2] *In Parmenidem*, St. 610 (Cousin v. 4) *καὶ δεῖ λαβεῖν ἐκ τούτων ἐχεγγυωτέρων ὄντων ὅτι ἄρα οὐ μόνον τῶν ὁριστῶν* (v. l. *ὁριστικῶν*) *ἔσχεν ἔννοιαν ὁ Σωκράτης ἀλλὰ καὶ*

explained that Plato seriously means to say here that *Socrates* is responsible for the peculiar feature of this doctrine, viz. that it treats a 'thing' as simply a complex of 'universal' predicates, and we really have no right to set aside Plato's testimony. As for Aristotle's evidence, it is significant that he never refers to any change in the teaching of *Plato*, though, if Dr. Jackson is right, Plato must have reconstructed it from its foundations just at the time when Aristotle was entering the Academy. It is reasonable to infer that *he* at least did not regard the theory expounded in the *Phaedo* as ever having been Plato's. Again, it is notorious that Aristotle never refers to the dialogues as containing the theory he ascribes to Plato, though he does sometimes appeal to Plato's ἄγραφα δόγματα, 'unwritten lectures', apparently above all to the famous lecture on the 'Good' of which at least five auditors are known to have published their notes, Aristotle, Speusippus, Xenocrates, Histiaeus, and Heraclides of Pontus. Obviously it was this lecture, and not any of the dialogues, which was held by the Academy to be the key to Plato's philosophy.[1]

According to the well-known account of Aristotle (*Met.* A. 6), Platonism and Pythagoreanism were in the main at one. There was a difference, which Aristotle regarded as merely verbal (τοὔνομα μόνον μετέβαλεν, loc. cit. 987[b] 10), viz. that the Pythagoreans said

αὐτῶν τῶν χωριστῶν εἰδῶν, οὐδ', ὡς Ἀριστοτέλης φησίν, ἐπήχθη ἂν εἰς τὴν ἐκείνων θέσιν ἐκ τῆς περὶ τοὺς ὁρισμοὺς διατριβῆς, ἀλλ' ὅτι διὰ θείαν ὄντως ὁρμὴν καὶ ταῖς ἰδέαις αὐτὸς ἐπέβαλεν· ὅπου καὶ νέος ὢν δῆλός ἐστιν ἐγηγερμένος εἰς τὴν ἐκείνων θεωρίαν αὐτὸς παρ' ἑαυτοῦ.

[1] Once or twice when Aristotle is raising particular difficulties about the doctrine of Forms he refers to the *Phaedo* in a curious way as 'what Socrates says in the *Phaedo*', as though he were in doubt whether what is taught there can be taken as committing Plato. Thus at *Met.* A. 9. 991[b] 3, where he is making a difficulty about the causality ascribed to the Forms, he says ἐν δὲ τῷ Φαίδωνι οὕτω λέγεται, 'but in the *Phaedo* the language states that', &c. So again, *de Generatione* B. g. 335[b] 9, 'some thought that the Forms (τὴν τῶν εἰδῶν φύσιν) are an adequate cause of Becoming, ὥσπερ ὁ ἐν Φαίδωνι Σωκράτης, where it is really notable that he does not refer the doctrine to Plato. So far as I know, Aristotle *never* alludes to anything in the *Phaedo* as 'Plato'. It is clear that he does not rely on any dialogues at all for what he tells us about Plato's Forms. The points which in *Met.* A. 6 he calls ἴδια Πλάτωνος, the things which distinguish Platonism from Pythagoreanism, are not really mentioned in the dialogues. The only dialogue to which Ar. refers for the εἴδη is the *Phaedo*, and he refers to that mainly for the one statement that the εἴδη are the causes of γένεσις and φθορά in sensible things, a statement which he describes as the view of Socrates. Aristotle's practice in this matter fits in with the language used about the dialogues in Plat. *Ep.* ii. 314 c, 'I myself have never put any of this in writing; there is not and never will be a work of Plato; what are now called so are utterances of Socrates rejuvenated and made handsome'.

that things 'imitate' numbers, Plato that they 'partake' of number (*οἱ μὲν γὰρ Πυθαγόρειοι μιμήσει τὰ ὄντα φασὶν εἶναι τῶν ἀριθμῶν, Πλάτων δὲ μεθέξει* ibid. 11–12). But since neither party gave any explanation of what was meant by these formulae (*ἀφεῖσαν ἐν κοινῷ ζητεῖν* ibid. 14), this is a mere difference about words. Aristotle's evidence seems to me to show that it is a mere error to suppose that Plato ever substituted the formula about 'imitation' for that of 'participation'. Aristotle has been charged with *mala fides*, but the good faith of his representation seems to me guaranteed by two considerations. His language agrees exactly with that of Plato himself in the *Parmenides*, where the view that things are 'imitations' of the Forms is suggested simply as a possible *interpretation* of the formula about 'participation' (*Parm.* 132 d 3 *καὶ ἡ μέθεξις αὕτη τοῖς ἄλλοις γίγνεσθαι τῶν εἰδῶν οὐκ ἄλλη τις ἢ εἰκασθῆναι αὐτοῖς*). Also, the supposed abandonment of the 'participation' formula left no trace whatever on the terminology of the Academy. Down to the very last age of Greek Neo-Platonism *μέθεξις* and the equivalent *μετοχή* continue to be the standing Academic terms for the relation between 'things' and Forms. When we remember the abundant evidence for the unbroken continuity of the Platonic tradition, this seems to me proof that the alleged substitution of a theory of 'imitation' for one of 'participation' never took place.

What Aristotle regards as peculiar to the theory he had learned in Plato's Academy and as distinguishing it from Pythagoreanism was something different. (1) The Pythagoreans said not only that things 'imitate' numbers, but that numbers are actually the *stuff* of which things are made. But Plato said that his Forms or numbers are different from both sensible things and geometrical figures. (2) He said that in the Forms themselves there are two constituents, the 'One' (which is also the 'Good'), and the 'great-and-small' or 'indeterminate duality'. The Pythagoreans had similarly derived *their* numbers from the 'One' (itself a union of the 'unlimited' and the 'limit'). But it is peculiar to Plato to replace the 'unlimited' by a *duality* of the 'great-and-small'. These two points are all that Aristotle regards as *ἴδια Πλάτωνος*, peculiarities discriminating Platonism from Pythagoreanism.[1]

[1] The passage is so important that I subjoin a full version of it (*Met.* A. 6. 987^{b} 11 ff.): 'The Pythagoreans said that things "imitate" their numbers, Plato that they "partake" of them—a mere change of a word. But what this "participation" or "imitation" of the Forms can be they left undetermined. Also he says that, over and above the sensible things and the Forms, the "mathematicals" are something

This is not the place to discuss the full meaning of the statements which Aristotle calls ἴδια Πλάτωνος. M. Robin has devoted a large and learned work to them without by any means exhausting the subject. And our immediate problem is not what these statements mean, but whether anything like them is said in the *Timaeus*. I think it will be clear to any one who does me the honour to study the present commentary with an open mind that nothing like this is said anywhere in our dialogue. The one dialogue in which something *is* said which is *like* what Aristotle tells about the 'Great-and-Small' is the *Philebus* (24 a–25 b), and even there it is very significant that the categories with which Socrates is working are the Pythagorean, not the Platonic. He tells us that as a matter of fact every ἄπειρον is something which permits of indefinite variation in the two directions of more and less (24 e), but formally his two initial categories are the Pythagorean pair, ἄπειρον and πέρας, not the Platonic pair the *One* and the ἄπειρον of the more-and-less. Now it is just in the view that the One is not 'the first blend of ἄπειρον and

intermediate. These differ from sensible things in being eternal and invariable, from the Forms in that there are many of them like one another, whereas each Form is one and unique. And since the Forms are causes of everything else, he thought that the constituents (στοιχεῖα) of *them* are constituents of everything that is. Their material principle is the Great-and-Small, their formal principle (οὐσία) the One. For the Forms, or Numbers, are derived from the former [i. e. the Great-and-Small] by participation in the One.

'Now in saying that the One is a Substance (οὐσία), and not a predicate of something else, he agrees with the Pythagoreans, as he does also in saying that the Numbers are causes of the *essentia* [or substance, οὐσία] of everything else. But to set up a duality instead of the unlimited regarded as one thing, and to make the unlimited of the Great-and-Small—that is distinctive of him. So it is also that he says that the numbers are distinct from sensible things (παρὰ τὰ αἰσθητά), whereas they (the Pythagoreans) say that the numbers *are* actually the things (τὰ πράγματα). And they do not place mathematicals between the two. The making of the One and the numbers something distinct from things—a deviation from Pythagoreanism—and the introduction of the Forms was due to the study of things in propositions [a plain allusion, as Bt. has said, to *Phaedo* 99 d–100 a], for the earlier thinkers had not touched dialectic; the making of the second constituent (τὴν ἑτέραν φύσιν) into a duality was due to the ease with which the numbers—except the first ones—[ἕξω τῶν πρώτων—it is not relevant to discuss here the interpretation of this difficult phrase] can be generated from it (viz. the duality) as a matrix.'

This is far the fullest and most authoritative record we possess of what Plato taught about the Forms in the Academy, and ought to be the starting-point for any serious discussion of Platonic metaphysics. We are not bound by Aristotle's speculations about Plato's meaning, we are bound by his plain account of what Plato *said*.

On the whole passage cf. Bt. *EGPh.*[3] c. 7 and Robin *La Théorie Platonicienne* passim.

πέρας', but one of the two *ultimate* categories that Platonism is most obviously at variance with Pythagoreanism. Yet we see that in the very dialogue which comes nearest to an expression of what we know from Aristotle to have been Plato's thought, Socrates is still made to work with the Pythagorean ideas. If this is how Plato treats Socrates, *a fortiori* we should not expect to find Platonism put into the mouth of an Italian Pythagorean, who must have been twenty to twenty-five years or more Socrates' senior.

We are safe, then, I think in asserting the following propositions. (1) There never was any distinctively *Platonic* doctrine about the Forms except that which Aristotle tells us he heard Plato himself expound. Plato, then, must have held the views described in the *Metaphysics* at least from 367, the year in which Aristotle entered the Academy, and may have held them for an unknown length of time before. They were thus definitely formulated by the time the *Theaetetus* was written. (2) This doctrine is not the same as that which Socrates expounds in the *Phaedo* and *Republic*, though it is developed out of it. The natural inference is that Plato did not reach a *distinctive* doctrine of his own, going beyond that which he attributes to Socrates and a whole group of his associates, until late in life, just as Kant did not put forth a Kantian philosophy until he was within three years of sixty. (3) The distinctively Platonic doctrine is not to be found in the *Timaeus*, except possibly in one hint (53 d 6–7), which no one could understand without Aristotle's statement to explain it. (I hope to show in a note on this passage that even here a reference to anything distinctively Platonic is very *improbable*.) All that we get in the *Timaeus* is just the doctrine that there *are* eternal Forms as well as perishable things which are 'copies' of them, and this is *not* any part of what Aristotle regarded as distinguishing Platonism from Pythagoreanism. It is even notable that though the *Sophistes* had laid the foundations of a theory of predication by pointing out the difference between negation and bare 'not-being', Timaeus always talks of the μὴ ὄν in the old undiscriminating fashion familiar to us from the fifth book of the *Republic*. For anything that he says, there might be no distinction at all between the μὴ ὄν which is 'just nothing at all' and cannot even be thought of, and the μὴ ὄν which is 'what is different from something that is'. Similarly, he knows nothing of the thought which permeates the *Philebus* that all 'becoming' is γένεσις εἰς οὐσίαν, a process which results in 'being'; he treats γένεσις and οὐσία from first to last as simple incompatibles. We

shall thus expect to find that after all, so far as the Forms and their relation to 'things' are concerned, there is no substantial difference between the teaching of Timaeus and that of the *Phaedo*. To establish this must, of course, be the task of my detailed commentary on the section of the *Timaeus* which is relevant to the problem (51 b 7–52 a 7).

I believe, however, that a careful exegesis of this passage will show that the *only* difference is the verbal one that whereas the *Phaedo* speaks of the 'participation' of sensible things in Forms (μέθεξις) or of the 'presence' (παρουσία) of Form to thing, the *Timaeus* speaks always of 'things' as 'images' (εἰκόνες) which 'imitate' the Forms which are called their 'models' (παραδείγματα). The explanation of this is childishly obvious; the speaker in the *Timaeus* is a Pythagorean, and, as Aristotle says, 'imitation' was in fact the standing Pythagorean word.

A more reasonable explanation of Socrates' silence about *Rep.* vi–vii is that given by Bt. (*Greek Philosophy: Thales to Plato* p. 339), viz. that the account of the sciences given in the *Republic* would no longer be adequate, now that they had been advanced so notably by Plato's own Academy, and that the *Timaeus* itself was meant to replace this account. Solid geometry, for example, which is said in the *Republic* to be still an unexplored field, had been enormously advanced by Theaetetus; the study of quadratic surds had been placed on a scientific basis and the beginning made with the geometry of the conic sections. Again, a great part of the dialogue is really a treatise on mathematical physics inspired by the thought that the 'appearances' of the sensible world are to be explained by the geometrical structure of the corpuscles of bodies. This goes far beyond anything in the *Republic*, and the only justification for putting such ideas into the mouth of Timaeus is that the Pythagorean theory of 'number' as the stuff of things is the starting-point of the theory. This might explain the absence of all reference to that part of the *Republic* which describes the scientific education of the philosopher-kings.

But I suspect that the real explanation is simpler still. The true object of the recapitulation of the *Republic* is to prepare the way for the narrative to be given by Critias of the great Athenian repulse of the Atlantids. Now Plato lets us see clearly enough in the *Republic* itself that he knew well that the rule of the philosopher-king is not fully attainable in the actual 'world as God made it'. It is a 'pattern laid up in heaven'; but whether it will ever be

realized on earth is an open question. This being so, it is reasonable that he should not put too great a strain on our powers of belief by his picture of the heroism and moral elevation of pre-historic Athens. It is *artistically* right to ask us to believe only that the Athenians of that far-away time had attained the more realizable level of goodness described in *Rep.* i–v. This would be enough to account for their victory over the materially rich but morally decadent civilization of Atlantis, and Plato presupposes no more than the story demands.

E. SUBSIDIA TO THE STUDY OF THE DIALOGUE.

The text of the *Timaeus* is remarkably well preserved, as we have for it, besides the famous Paris MS. A (collated by Bekker, by Bast, whose collations were given, unfortunately, in a very inaccurate form, at the end of Stallbaum's edition, and recently by Bt.), the two Vienna MSS., F and Y, of which F is exceptionally important for the number of true readings it preserves alone or alone with one other good MS. We shall have frequent occasion to see how many of the few *certain* corrections made in the first instance by conjecture are now known from F to be genuine ancient readings. Bt.'s text of the dialogue is the only one on the level of modern requirements, as no earlier editor had the use of F.[1]

The very numerous quotations from the dialogue in Plutarch, Galen, Theon of Smyrna, Eusebius, Stobaeus and other writers are valuable as they often enable us to discover what was the text read in the second to the fifth centuries A. D., and thus take us back behind the probable date of the common archetype of our good MSS.

From antiquity we have in the way of translation or commentary: (1) fragments of a Latin version by Cicero (the parts of the text represented being 27 d 6 *τί τὸ ὂν ἀεὶ*—37 c 1 *ὅταν δ' αὖ περὶ τὸ λογιστικὸν ᾖ*: 38 c 3 *ἐξ οὖν λόγου καὶ διανοίας θεοῦ*—

[1] For full particulars about these two important MSS. the reader may be referred for A to Bekker's edition of Plato, vol. i, p. 7, for F, to Schneider's edition of the *Republic*, vol. i, p. xvii, and Bt.'s preface to vol. iv of his text of Plato. The readings of A were collated by Bekker in vols. ix and x of his edition, and also, for the *Timaeus*, by Bast. Bast's collation is printed by Stallbaum at the end of his edition of the *Timaeus* and *Critias* (1838). The grave discrepancies between Bekker's collation and Bast's as given by Stallbaum appear to be mainly due to Stallbaum's inability to decipher Bast's notes. Both F and A were carefully collated for Bt.'s text, F by the late Prof. Král, A by Bt. himself. By the kindness of Prof. Burnet I have been permitted to use both these collations for the purpose of the present work.

43 b 4 *κάτω τε καὶ ἄνω καὶ πάντῃ*: 46 a 5 *ἑνός τε αὖ περὶ τὴν λειότητα*—47 b 2 *δωρηθὲν ἐκ θεῶν*. Cicero's version, fragmentary and often not over literal, is in one or two difficult places singularly valuable in deciding a point of text or grammar. Its importance is that it lets us see something of the text as it was before its treatment by Dercylidas and Thrasylus. (2) Plutarch's valuable essay on the *Generation of the Soul of the World in the 'Timaeus'*, full of important information on the divergences of interpretation from the earliest days of the Academy. Plutarch's *Quaestiones Platonicae* also contain discussions of one or two special passages of the dialogue. (3) A translation of the dialogue down to 53 c 3 *συνέψεσθε* by Chalcidius accompanied by a commentary. The work is dedicated to a certain Hosius, apparently the Spanish bishop of that name who was prominent at the first council of Nicaea. Apart from the information contained in the commentary, much of which we shall see reason for believing to be derived from the lost commentary on the dialogue by the famous Stoic Posidonius,[1] (first half of the first century B. C.), the translation has high value as evidence for the

[1] It has recently been denied (by L. Reinhardt, 1921) that Posidonius wrote on the *Timaeus* at all. I have not been able to procure a sight of Reinhardt's work on Posidonius, but the denial seems to me futile. The express words of Sextus Empiricus (*Adv. Mathemat.* vii. 93) *φησὶν ὁ Ποσειδώνιος τὸν Πλάτωνος Τίμαιον ἐξηγούμενος* appear to have only one possible meaning. Ὁ Πλάτωνος Τίμαιος must mean Plato's dialogue *Timaeus*, and Sextus must intend to say that P. made an *ἐξήγησις* of the *dialogue*. It appears from the context that what Sextus is quoting is P.'s explanation of the *ψυχογονία*, and particularly of the point that *our* souls are made of the same components as that of the whole *οὐρανός*, in fact, that both are 'made of number' (*loc. cit.* 94 ff.). Sextus goes on to develop the view that bodies themselves are made so as to be only comprehensible by numerical laws (*loc. cit.* 101–3), and in enforcing the point uses the regular Stoic technicalities (*τὰ μέν ἐστιν ἐκ συναπτομένων . . . τὰ δὲ ἐξ ἡνωμένων, ἅπερ ὑπὸ μιᾶς ἕξεως συνέχεται* κτλ.), so that he is evidently following a Stoic source. It is suggestive again that in 107 he illustrates the importance of *ἀναλογία* in all *τέχναι* by the method by which the people of Rhodes (the very place where Posidonius taught) estimated the cost of erecting their famous Colossus. As Sextus goes on to quote the proem to the poem of Parmenides and to subjoin an interpretation (*loc. cit.* 112–14) which is expressed in Stoic terminology about *λόγος* and *κατάληψις*, he is pretty plainly still following a Stoic authority. He returns again at 117 to the *Timaeus*, comparing what is said about the 'knowledge of like by like' at *Tim.* 45 b with the similar language of Democritus. In the course of the argument (119), he represents the reasoning of the *Timaeus* as follows, *εἰ γὰρ ἡ μὲν ὅρασις, φησί, φωτὸς ἀντιλαμβανομένη εὐθύς ἐστι φωτοειδής, ἡ δὲ ἀκοὴ ἀέρα πεπληγμένον κρίνουσα, ὅπερ ἐστὶ τὴν φωνήν, εὐθὺς ἀεροειδὴς θεωρεῖται, ἡ δὲ ὄσφρησις ἀτμοὺς γνωρίζουσα πάντως ἐστὶν ἀτμοειδὴς καὶ ἡ γεῦσις χυλοὺς χυλοειδής, κατ' ἀνάγκην καὶ ἡ ψυχὴ τὰς ἀσωμάτους ἰδέας λαμβάνουσα . . . γίνεταί τις ἀσώματος*. Now since Plato never 'says' anything like this, and, in fact, some of the statements, especially that about the eye and the light, are hardly compatible

text older than any existing MS. (4) A long commentary of the Neo-Platonist Proclus (only extant as far as 44 d). The commentary was completed by Proclus in his twenty-eighth year (A. D. 437–8), but, of course, may have been revised and enlarged at various times in the course of his long life (410–85 A. D.). Proclus has often been underrated in modern times, mainly on account of his fondness for reading into Plato a fantastic theology based on 'Orpheus' and the so-called 'Chaldaean oracles', but it is really quite easy to allow for this weakness. In discussing the science of the dialogue he always shows both sound sense and wide learning, and his extensive knowledge of earlier relevant literature makes him an invaluable aid. Modern interpreters would often have escaped some of their most serious errors if they had taken sufficient account of their Neo-Platonic precursor. It is unfortunate that Proclus devotes most of his attention to the views of commentators from his own school, such as Porphyry, Iamblichus, Theodorus of Asine and others, when it would have been much more desirable from our point of view to be told more of the interpretations current before the rise of Neo-Pythagoreanism and Neo-

with the theories of Timaeus, it is pretty clear that Sextus is still following an 'interpretation' of the whole dialogue. So the attempt at vii. 124 to get out of Empedocles the doctrine that the *κριτήριον* is 'not sense but *ὀρθὸς λόγος*' is pretty clearly Stoic, and it is reasonable to infer that all through the long passage about the *κριτήριον* from which these references have been taken (vii. 89–140), Sextus is making large use of a Stoic commentary on the *Timaeus*, and that he names its author by his reference to Posidonius. So we may also ask from what source Plutarch derived the information he gives us in his own essay on the *Psychogony of the 'Timaeus'* about the views of *οἱ περὶ Ποσειδώνιον* (Plut. *Moral.* 1023 b). What are the sources of the highly Stoicized interpretations favoured in Chalcidius? I submit that the facts hardly admit of any interpretation but one, that Posidonius had offered an elaborate explanation of at least one passage of importance in our dialogue, *Tim.* 35 a–36 b, the description of the *ψυχογονία*, and that, if we take the words of Sextus, *φησὶν ἐξηγούμενος τὸν Πλάτωνος Τίμαιον*, in their only natural sense, the explanation was given in a work which dealt with the dialogue as a whole, and that Sextus had the work before his eyes. For further discussion of the evidence that there was a recognized Stoic exegesis of the dialogue, I must refer to the body of the commentary which follows. One important testimony is Theon Smyrn. 103–4 (Hiller), where we are told that Plato 'follows nature' in using a set of 'seven numbers' for the construction of the soul in the *Timaeus*. 'For, *as Posidonius says*, day and night have the nature of even and odd, and a month consists of four weeks . . . and growth is determined by weeks, &c.' We have evidently here a reference to the same source as that used by Sextus, and, as Theon, like Sextus, expressly says *φησί*, not *ἔφη* (*ὥς φησι Ποσειδώνιος*), it seems to me illegitimate to take the source for anything but an actual written exposition, though we cannot be *sure* that Theon is quoting at first hand, as I think we can be sure that Sextus is.

Platonism, but the fault is one which is incident to commentators. And both Proclus and the much calumniated Iamblichus have the merit of rejecting most of the more extravagant fancies of Porphyry and Theodorus. (5) The criticisms of Aristotle on the physics (chiefly to be found in *de Caelo* and *de Generatione*) and sense-physiology (*de Anima* and elsewhere) of the dialogue, and those of Theophrastus on the latter subject (in the *de Sensu*, the one surviving section of the great work *περὶ φυσικῶν δοξῶν*) are valuable evidence for the interpretation put upon passages of the dialogue by men who had been personal associates of Plato and had heard him expound his philosophy with the living voice. I trust that in the notes of this volume I have taken full account of the whole of this testimony. (6) One must also take into account the fragment with the title ΤΙΜΑΙΩ ΛΟΚΡΩ ΠΕΡΙ ΨΥΧΑΣ ΚΟΣΜΩ. This was mistaken by the Neo-Platonist commentators for a genuine work of the Locrian Timaeus used by Plato as the basis of his dialogue. It is now recognized as a production of the first century A. D., a mere extract from Plato done into a conventional Doric. But it is sometimes useful in throwing light on disputed points of reading or grammar, and is evidence for the interpretation of difficult passages current at the date of its fabrication.

There is no wholly adequate modern commentary. That of Stallbaum is always scholarly and deals well with most questions of language and grammar. On the philosophy he says little; his notes on the science usually follow August Boeckh,[1] the best

[1] The relevant works of Boeckh are:

1. *Ueber die Bildung der Weltseele im Timaeus des Platon* (1806, reprinted in vol. iii of Boeckh's *Kleine Schriften*, pp. 109-80).

2. *Specimen editionis Timaei Platonis dialogi* (1807, reprinted in *Kleine Schriften* iii, pp. 181-203).

3. Explicatur *Platonica corporis mundani fabrica conflati ex elementis geometrica ratione concinnatis* (1809, reprinted in *Kleine Schriften* iii. 229-65).

4. *De Platonico systemate coelestium globorum et de vera indole astronomiae Philolaicae* (1810, *Kleine Schriften* iii. 266-92).

5. *Untersuchungen über das kosmische System des Platon* (1852. In reply to the treatment of Plato in Gruppe's work, *Die kosmischen System der Griechen*).

6. *Appendix* to the reprint of 4. I. *Platons Timaeus enthält nicht die Achsendrehung der Erde* (a reply to Grote's pamphlet mentioned below). II. *Vom Philolaischen Weltsystem* (1863-4, *Kleine Schriften* iii. 294-322).

The works of Grote to which reference is made above are:

1. *Plato and the other Companions of Socrates* ch. 38 (vol. iv, pp. 215-70 of the edition of 1885).

2. *Plato's Doctrine respecting the Rotation of the Earth and Aristotle's Comment upon that Doctrine*, 1860 (reprinted in *Minor Works of George Grote*, London, 1873, pp. 237-56).

authority available to him, but the whole history of early Greek science has been put in so new a light since Boeckh wrote that Stallbaum's notes are now very inadequate. Far the most learned edition of the dialogue is that of T. H. Martin with French translation and elaborate notes and essays (*Études sur le Timée de Platon*, Paris, 1841). Its only serious fault is that it was produced before the rise of that more critical study of the history of Greek science which begins with, but must not stop at, Zeller's monumental *Philosophie der Griechen*. Grote (in *Plato and the other Companions of Socrates*) is always thoroughly scholarly and, in his war of pamphlets with Boeckh, had the merit of being right, where Boeckh was wrong, on the important point that, as Aristotle said, the dialogue ascribes a motion to the earth. But he is too ready to credit Plato with inconsistencies, and the scope of his work compels him to pass over much of the highest importance in silence. The one recent English edition of the dialogue, that of R. D. Archer-Hind (London, Macmillan, 1888), must be reluctantly pronounced unsatisfactory. The editor's zeal is admirable, but he had not the knowledge required to do the work he had set himself properly. The text is far from trustworthy as the editor was ignorant of the readings of F and not always rightly informed about those of A, the only manuscript of which he took any serious account. It is still more unfortunate that his exegesis is throughout inspired by the determination to force on Plato a philosophy of his own devising, a sort of conflation of Spinozistic monism with the kind of 'idealism' popularly supposed to be taught by Berkeley. J. Cook Wilson's hostile pamphlet on the *Interpretation of Plato's Timaeus* (London, Nutt, 1889), is learned and *often* right in its criticisms, especially on points of language, but its tone is deplorably bitter. I do not think it contributes very much to the actual interpretation of the dialogue. On the *chief* issue raised about facts, that of the motion ascribed by Timaeus to the planets Mercury and Venus, A.-H., in spite of blunders in matters of detail, is very near being right, and C. W. is pretty certainly wrong, as will be shown in the proper place. The discussion of readings is defective, like all discussions of the text of our dialogue which ignore the existence of F. I have also consulted two more recent translations of the dialogue, *Platone Il Timeo*, tradotto di G. Fraccaroli, Turin, 1906 (with copious notes), and O. Apelt *Platons Dialoge Timaios und Critias*. Übersetzt und erläutert, Leipzig, 1919. The chapters which deal with the dialogue in vol. ii of

C. Ritter's *Platon* as well as the treatment of it in the *Platon* of Wilamowitz seem to me too much under the spell of Boeckh and of Archer-Hind.

A student of the *Timaeus* needs to be well read in the early history of Greek physical doctrines, especially Pythagoreanism, and the systems which attempt to connect medicine and biology with cosmological theory (Empedocles, Diogenes of Apollonia). The actual texts in Diels's *Fragmente der Vorsokratiker*[3] and Bt.'s discussion of them in *EGPh.*[3] as well as Tannery's treatment in *Pour la science hellène*, should be carefully studied. It is well also to know at any rate as much as will be found in vol. i of Gomperz's *Griechische Denker* of the history of early Greek medicine. For the physical parts of the dialogue Aristotle's *de Caelo* B and *de Generatione* are of the first importance, and for the psychological Aristotle's *de Anima* and *Parva Naturalia* and the *de Sensu* of Theophrastus. The best modern aid to the study of this side of the *Timaeus* is probably Beare's *Greek Theories of Elementary Cognition, Alcmaeon to Aristotle* (Oxford, 1906). Almost the only early Greek thinkers whose views do not concern the student of the dialogue are the Eleatics, who regarded the appearances of Nature as mere illusion, and the Atomists, of whom Plato seems to have known little or nothing. (The most important passages of the earlier physicists are conveniently collected in Ritter and Preller *Historia Philosophiae Graecae*[9]. A student of the *Timaeus* should have this work and *EGPh.*[3] always at hand.) For the early history of astronomy Sir T. L. Heath's *Aristarchus of Samos* is invaluable.

This is, perhaps, the most appropriate place for a word or two about an ancient scandal connected with our dialogue, which first appears in some verses of the satirist Timon of Phlius (*c.* 325–*c.* 235 B.C.). Timon, who sets himself to decry all the philosophers except his own preceptor, Pyrrho of Elis, said of Plato πολλῶν ἀργυρίων ὀλίγην ἠλλάξαο βίβλον | ἔνθεν ἀπαρχόμενος τιμαιογραφεῖν ἐδιδάχθης (Timon *ap.* Aul. Gell. iii. 17; R. P. 60a), 'for many pieces of silver thou didst procure a little book, and starting from it didst learn to write *Timaeus*'. This is the first extant reference to the story, but it is implied that it was already current when Timon composed these lines. The reference cannot be to the existing *Timaeus Locrus*, though the tale may possibly have provided the suggestion for the fabrication of that fragment. It is not said that the 'little book' had any connexion with Timaeus or any other known person. The suggestion seems to be merely that Plato procured some written Pythagorean document not generally accessible, and based the cosmological and biological theories of his *Timaeus* on it. In the next century the story appears in a more circumstantial form. Plato is said to

have bought the book or books in question from the relatives of Philolaus, (Hermippus, a pupil of Callimachus), or to have got it through the good offices of his friend Dion (Satyrus, the Alexandrian biographer, a pupil of Aristarchus). Ultimately, in the first century B. C., Demetrius Magnes quotes the opening words of the book (*Fr. d. Vors.*[3] i. 309; R. P. 63 b). There is no doubt that the work from which he is quoting is that from which all the so-called fragments of Philolaus, most readily accessible in the first volume of *Fr. d. Vors.* are taken. (See Bywater in *Journal of Philology* i. 21 ff. and the discussion of the story in *EGPh.*[3] 279–84.) Now the extracts from this work do not contain much which is like anything in the matter of the *Timaeus* beyond a passing reference to the five 'regular solids', and probably to their inscripiton in the sphere (Philol. Fr. 12, *Fr. d. Vors.*[3] i. 314 *τὰ μὲν τᾶς σφαίρας σώματα πέντε ἐντί* κτλ.), and a statement of the simple ratios corresponding to the musical intervals of the fourth, fifth, and tone (Philol. Fr. 6, *Fr. d. Vors.*[3] i. 311). The main doctrine of the fragments, that all things are a blend of 'limit' and 'unlimited', is much more closely akin to the metaphysical section of the *Philebus* (16 c ff.). Hence it is not likely that the identification of the book said to have been bought by Plato with the work from which these extracts are taken belonged to the earliest form of the story. Timon does not mention Philolaus; and Hermippus and Satyrus, who do, do not speak of him as the author of the book which Plato procured. The suggestion is rather that the book professed to be by Pythagoras himself, or at least to be an authentic account of his teaching, and that it was naturally in the possession of Philolaus as the last remaining head of the society. It is a different question whether any of the extracts we possess are genuine fragments of Philolaus or not, and opinion is not as yet unanimous on the point. Diels, for example, still regards most of them as genuine. For the full discussion of the question I must be content to refer to the arguments of Bt. *EGPh.*[3] *loc. cit.* I think myself that Bt. is right in regarding all the alleged fragments as spurious, first because, as he says, they at least seem to refer to the inscription of the five regular solids in the sphere, and we have good evidence that the inscription of two of them, the octahedron and icosahedron, was first discovered in the Academy itself by Plato's friend and associate Theaetetus (*EGPh.*[3] 284 n. 1). This, in fact, is why the regular solids were habitually called the *σχήματα Πλάτωνος*, 'figures of Plato'. Second, because it is reasonably certain that if Philolaus wrote anything he must have written in Ionic, the regular language for scientific works in the fifth century, whereas the 'fragments' are in purely conventional Doric. Thus the story seems to amount to nothing more than the suggestion, in no way discreditable to Plato, that his Pythagorean science in the *Timaeus* is based on authentic fifth-century foundations. But there is no sufficient ground for supposing that Plato would have to depend on books of any kind for his knowledge of Pythagorean theories, even if there were any ground for supposing that the early Pythagoreans wrote scientific books. We must remember that the relations of Socrates with Pythagoreans are attested not only by Plato's *Phaedo* and *Timaeus* and by Xenophon's inclusion of

Simmias and Cebes, the pupils of Philolaus, among the Socratic men, but also by the remains of the *Telauges* of Aeschines of Sphettus. (See Bt., article SOCRATES, in vol. xi of *ERE.*) And Archytas of Tarentum, the leading figure in the revived Pythagoreanism of the fourth century, was among Plato's personal friends. Thus it is not necessary to regard Plato's knowledge of Pythagorean theories as derived from books at all. It therefore seems to me probable, though not demonstrable, that Bt. is right in suggesting that the whole story of the 'little book' may have been no more than one of the *rodomontades* of the notorious Aristoxenus of Tarentum. The great aim of Aristoxenus appears to have been to eliminate the 'other-worldly' strain from the Pythagoras tradition, and to represent Pythagoras simply as a brilliant secularistic man of science. In particular, he is known to have held strongly the theory which the *Phaedo* ascribes to Simmias, a Theban pupil of Philolaus, and to the Phliasian Pythagorean Echecrates, that the soul is just the 'attunement' (*ἁρμονία*) of the body, and perishes when the body is dissolved by death. From his point of view men who, like Socrates in the *Phaedo* and Plato in the *Laws*, insist on treating the soul's 'separability' from the body and its immortality as truths of the first moment were depraving the tradition of science by reviving discredited superstitions. This may explain why Aristoxenus seems always anxious to exhibit Socrates and Plato in an unfavourable light.

The balance of probability, then, seems to me to be decidedly against the genuineness of all the alleged fragments of Philolaus. But I do not believe the work from which the fragments accepted by Zeller and Diels are taken to be a 'forgery'. The doctrines set forth in the 'fragments' seem to me to be wholly in keeping with what writers like Aristotle tell us about Pythagorean views, though the reference to the 'five bodies in the sphere', if it alludes to the geometrical 'inscription' of these bodies, shows that we are dealing with a writer who has been influenced by Academic mathematics. The most natural explanation at once of the general fidelity of the 'fragments' to what we know to be fifth-century Pythagorean doctrine and of their use of Academic geometry, as well as of the dialect in which they are written, seems to me to be one which was first suggested to me by Professor Burnet in conversation. Pythagoreanism was revived in the fourth century at Tarentum by Archytas and his associates. Archytas would be abreast of the geometrical discoveries of the contemporary Academy, and as a Tarentine he used the Doric dialect, exactly as Archimedes of Syracuse did in the following century. Everything in the alleged work of 'Philolaus' explains itself if we suppose it to be really an anonymous Italian or Sicilian Pythagorean treatise of the fourth century which was mistaken in Alexandrian times for a composition of Philolaus. I feel sure that it is a mistake to put the work on the same level as Alexandrian forgeries of the first century B. C.

Throughout the following pages Plato, Herodotus, Thucydides, Aristophanes, Euripides are commonly cited from the texts of the Oxford *Bibliotheca*, Aristotle usually from that of Bekker, except

where there exist good later revisions of the text. For the *Ethics* and *Poetics* I have used the text of Bywater, for the *Politics* that of Immisch, for the *Respublic. Atheniens.* Blass-Thalheim. Hippocrates is, for the sake of uniformity, usually quoted from the edition of Kühn, except for the contents of the unfinished Teubner text of Kühlewein. For Proclus I have used the Teubner texts wherever they exist, for Plotinus that of H. F. Müller, for Philo Judaeus that of Richter, for Sextus Empiricus that of Mutschmann, so far as it has proceeded. For the fragments of early Greek philosophers and the texts of the 'doxographers' I have used both Diels's *Fragmente der Vorsokratiker*, ed. 3, and his *Doxographi Graeci*, and, as a convenience to the student, I have also given frequent references to Ritter and Preller. The references to the *Grammar* of Matthiae and the *Syntax* of Madvig are to the English translations.

PROPOSED DIVERGENCES FROM PROFESSOR BURNET'S TEXT

22 d 6 λυόμενος	l. † λυόμενος † (? an αὐξόμενος. C. W.)
25 d 5 πηλοῦ κάρτα βραχέος	l. πηλοῦ κάρτα βαθέος (A)
39 a 1–2 ἰούσης τε καὶ κρατουμένης (cum MSS.)	l. ἰωῦσάν τε καὶ κρατουμένην (ut vid. Cicero, Chalcid.)
40 c 4 [περὶ]	l. ⟨τὰ⟩ περὶ
40 c 8 ἀλλήλοις ἡμῖν τε	l. ἀλλήλοις, ἡμῖν τε
40 d 2 τούτων αὖ τῶν	? l. τούτων αὐτῶν (F)
41 a 7 θεοὶ θεῶν, ὧν	l. θεοί, ὅσων (ὅσων Badham)
42 e 7 τάξιν	l. ⟨πρόσ⟩ταξιν (F)
45 b 7 ῥεῖν λεῖον	l. ῥεῖν, λεῖον
48 d 3 μηδενὸς ἧττον εἰκότα, μᾶλλον δέ, καὶ ἔμπροσθεν	l. μηδενὸς ἧττον εἰκότα, μᾶλλον δέ ⟨τῶν⟩ καὶ ἔμπροσθεν (ut et Hammer-Janssen)
49 e 3 τῷδε	l. τοῦδε
51 a 1 πάντων	l. † πάντων †
51 c 2 μόνα ἐστὶν τοιαύτην ἔχοντα ἀλήθειαν	l. μόνα ἔστιν, τοιαύτην ἔχοντα ἀλήθειαν
56 c 8 ἐκ δὴ πάντων ὥνπερ	l. ἐκ δὴ πάντωι, ὥνπερ
60 d 6 ἡμιπαγῆ	l. ἡμιπαγεῖ
60 e 1–2 κατὰ λόγον [νόμου]	l. κατὰ νόμον
61 b 4–5 τοῦτο πῦρ [ἀέρι] ἀπεργαζόμενα	l. τοῦτο πῦρ ⟨ὕδωρ⟩ ἀπεργαζόμενα (C. W.)

74 b 8 *ἔσεσθαι κτήματα*	?? l. *ἐσθήματα*
80 a 7–b 1 *ἐληλυθυίας, αἷς ὕστερον*	l. *ἐληλυθυίας αἷς ὕστερον* (sine interpunctione)
80 c 7 *τεθαυματουργημένα τῷ*	l. *τεθαυματουργημένα, τῷ*
84 a 2 *αὐτὸ ἐξ ἰνῶν † αἷμα*	?l. *αὐτὸ ἐκείνων ἅμα* (*ἐκείνων* Y, *ἅμα* St.)
91 b 2 *λαβὼν ἀναπνοήν, τοῦθ'*	l. *λαβὼν ἀναπνοὴν τοῦθ'* vel λ. *ἀναπνοὴν τοῦθ'*, (deletointer punctionis signo post *ἀναπνοήν*)

Nearly all these proposed divergences are upon mere points of punctuation, and in the absence of any generally recognized rules for the punctuation of Greek texts, I cannot even be sure that they all represent a divergence of opinion as to construction. Such as they are, my suggestions are all offered in a due spirit of deference to the judgement of my betters.

NOTES

17 a 1. The *object* of the reference to an unnamed absentee from the party seems to me to be this. The system expounded by Timaeus, though in general Pythagorean, does not agree wholly with any known Pythagorean theory. Hence it is pretended that Timaeus speaks as the *remplaçant* of some one who is purposely left unnamed. For ancient conjectures about the identity of this person see *Prolegomena*, p. 25. Proclus, apparently following Porphyry, correctly remarks that the absent personage is unknown personally to Socrates, *ξένος ἦν ὁ ἀπὼν καὶ ἀγνὼς αὐτῷ . . . τοσοῦτον ὁ Ἀττικὸς ὀρθῶς ἐπισημαίνεται· ἔοικεν ὁ ἀπολειπόμενος οὗτος εἶναι τῶν μετὰ Τιμαίου ξένων.*

As to the exact date of the conversation. According to *Republic* i. 354 a 11, the conversation with Thrasymachus and the others took place on the festival of Bendis. It is now two days later (17 a 2 *χθές* compared with *Republic* i. 327 a 1 *κατέβην χθὲς εἰς Πειραιᾶ*), and a festival of Athena (26 e 3 *τῇ παρούσῃ τῆς θεοῦ θυσίᾳ*). Proclus, writing after the establishment of Christianity, says that the Bendidea fell on the 19th of Thargelion, and *infers* that the festival of Athena afterwards referred to is the *lesser* Panathenaea, 'since the greater Panathenaea fell in Hecatombaeon'. (For this see Procl. in *Remp.* I. 18, 17, where it is also stated that the *μικρὰ Παναθήναια* follow on the Bendidea. Was Proclus's authority for this last statement Atticus who commented on Plato in the age of the Antonines?) The inference seems erroneous, as there is other evidence that the lesser Panathenaea really fell two months later. It has been suggested that Plato has made an oversight, but this is not likely. A modern writer would hardly be capable of making Epiphany and Good Friday, or Trinity Sunday and Michaelmas, fall in the same week. It is more natural to suppose that the reference of 26 e is not to the lesser Panathenaea but to some other festival connected with Athena, e. g. the Plynteria, which, according to Plutarch, were kept on the 26th of Thargelion. See the note on the passage in Fraccaroli.

17 a 4. ἀσθένειά τις αὐτῷ συνέπεσεν. 'He was suddenly indisposed.' Cf. [Plat.] *Axiochus* 364 c 8 *καὶ γὰρ ἤδη πολλάκις αὐτῷ γέγονεν συμπτώματος ἀνασφῆλαι*, 'to recover from an *attack*'.

17 a 5. τῆσδε . . . τῆς συνουσίας. It should not be forgotten that while any kind of social intercourse can be called *συνουσία*, *συνεῖναι* is also in the fifth century a technical word for the 'foregathering' of a professional teacher or 'sophist' with his pupils, and *συνουσία* is the equivalent of the German *Stunde* and the French *conférence*. The association is meant to colour the word here. Timaeus is about to deliver a 'lecture'. Cf. Xenophon *Mem.* A. vi. 11 *οὐδένα γοῦν τῆς συνουσίας ἀργύριον πράττῃ* (said by the 'sophist' Antiphon to Socrates), Plato *Protagoras* 335 b 7 *καὶ ἐν μακρολογίᾳ καὶ ἐν βραχυλογίᾳ οἷός τ' ἦ συνουσίας ποιεῖσθαι*, ib. 335 c 3 *ἵνα*

ἡ συνουσία ἐγίγνετο, *Sophistes* 217 d 8 αἰδώς τίς μ' ἔχει τὸ νῦν πρῶτον συγγενόμενον ὑμῖν μὴ κατὰ σμικρὸν ἔπος πρὸς ἔπος ποιεῖσθαι τὴν συνουσίαν, ἀλλ' ἐκτείναντα ἀπομηκύνειν λόγον συχνὸν κατ' ἐμαυτόν.

17 c 1–2. Constr. τὸ κεφάλαιον τῶν . . . λόγων περὶ πολιτείας ἦν κτλ. 'The main subject of my discourse was what I thought the best constitution for a city and from what kind of men such a city might be fashioned.' Fraccaroli wishes to construe differently, so as to get the sense, 'the main topic of my discourse on government was what kind of city government . . . I thought best'. This seems to me inferior. Socrates says that the κεφάλαιον of his discourse was about the best πολιτεία because the opening and concluding parts were about something else, the question what righteousness, τὸ δίκαιον, is.

18 a 10. ὅσα προσήκει τούτοις. τούτοις is, as Fraccaroli says, masculine, and refers to the φύλακες, 'the branches of study appropriate to them'.

18 b 3. ὡς ἐπικούρους μισθὸν λαμβάνοντας τῆς φυλακῆς. The selection of the word ἐπίκουροι in the *Republic* as the technical name for the army and police force of the ideal state demands a word of explanation. It was the regular title of the *professional* forces employed by a government and paid for their services. The employment of such paid professional guardians of law and order was opposed to the sentiments of the Athenian democracy, which never forgot the 'bodyguard' of Pisistratus and his sons. Hence we commonly find such a force spoken of by Athenian writers as μισθωτοί, 'mercenaries'. But we may be sure that their employers did not call them by any such invidious name. What *they* called them we see e. g. from the regular use of the word ἐπίκουροι in Herodotus for the Greek and Carian troops of the later Egyptian monarchs. When Socrates chooses the name for the professional soldiers of his city in the *Republic* he does so with a deliberate allusion to the distinction implied between the trained professional soldier and the mere citizen 'on commando'. This is why he is so careful to dwell on the point that the only μισθός his professionals are to receive is their 'keep'. They are ἐπίκουροι but *not*, in any real sense of the word, μισθωτοί. That this is really in his mind is proved by the assumption of the present passage that ἐπίκουροι of course get μισθός, though the μισθός in the case of his soldiers is a mere maintenance, ὅσος (*no more than*) σώφροσιν μέτριος.

(For the word cf. Herodotus ii. 163 πυθόμενος δὲ καὶ ταῦτα ὁ Ἀπρίης ὥπλιζε τοὺς ἐπικούρους καὶ ἤλαυνε ἐπὶ τοὺς Αἰγυπτίους. εἶχε δὲ περὶ ἑωυτὸν Καρὰς τε καὶ Ἴωνας ἄνδρας ἐπικούρους τρισμυρίους, ii. 169 ὅ τε Ἀπρίης ἄγων τοὺς ἐπικούρους καὶ ὁ Ἄμασις πάντας Αἰγυπτίους.[1]) Thus the associations of the word are much those of the English expression 'the Guards'. The current rendering of the word in the *Republic*, 'auxiliaries', obscures Socrates' real reason for choosing this designation for his *garde nationale*.

18 c 1. ὡς τὰς φύσεις τοῖς ἀνδράσιν παραπλησίας εἴη συναρμοστέον. The usual 'brachylogy' in a comparison for παραπλησίας ταῖς τῶν ἀνδρῶν φύσεσι. 'Their qualities were to be moulded by training on the same lines

[1] So Archilocus 30 (Hiller-Crusius) καὶ δὴ 'πίκουρος ὥστε Κὰρ κεκλήσομαι.

as those of the men', lit. 'so as to be similar to those of the men'. τοῖς ἀνδράσιν should be taken with παραπλησίας, not, as by some interpreters, with συναρμοστέον. The principles on which men and women are to be 'joined together' in wedlock are not mentioned until 18 d 7, the reference here is to the early training of the girls.

18 c 8. μηχανωμένους is obviously the true reading as against the facile μηχανώμενοι of F. Sc. τοὺς πολίτας or τοὺς φύλακας. The accusative depends on ἐτίθεμεν, which is, as C. W. says, virtually a 'verb of command' and takes the construction of one. 'We appointed their marriages . . . to be in common, they contriving ways to prevent any of their number from recognizing . . .' Buttmann's conjecture μηχανωμένοις gives the same sense, but forces on Plato a formal grammatical regularity which it is highly characteristic of his style to avoid.

18 d 2. ὅσοιπερ ἂν τῆς πρεπούσης ἐντὸς ἡλικίας γίγνωνται. The actual provisions of the *Republic* are more detailed. See *Rep.* v. 461 d–e, where we are told that all who are born in the tenth or seventh month after the 'nuptials of a given guardian' will be called his sons and daughters, and that 'the children born in the period when their fathers and mothers were procreating' (ἐγέννων 461 d 8) will be regarded as brothers and sisters, but brothers and sisters will be allowed to marry 'if the lot falls out so and the Pythia gives consent'. Richards, in the note on this passage in his *Platonica*, raises a curious difficulty. He takes the word ἐγέννων to refer to the *whole* period of life during which a guardian is liable to be called on to procreate children for the city. It follows from this (*a*) that most of the marriages would be between persons who are in the terminology of the *Republic* 'brothers and sisters', and (*b*) that the permission of brother-and-sister marriages will include what *we* should call incest, marriages between persons born of the same *actual* parents. Richards accepts both consequences and supposes that the 'consent of the Pythia', mentioned by Socrates, is *always* given as a matter of form. This is, to my mind, quite incredible. If we understand ἐγέννων as I feel sure it should be understood, the paradoxes vanish. The authorities keep a register of 'marriages' and births. Hence *they* know accurately exactly who are in our sense the 'parents' of every child. The demand for the 'consent of the Pythia' to a 'brother-and-sister' marriage is plainly meant to *prevent* 'incestuous' intercourse between persons who are actual brother and sister by blood. (The Pythia would be instructed secretly by the authorities when to refuse her assent.)

19 a 2. εἰς τὴν ἄλλην λάθρᾳ διαδοτέον πόλιν. This raises the question whether Plato does really in the *Republic* give any countenance to 'infanticide'. The immediate reference is to what is said in the *Republic* (460 c) about the 'concealing' of deformed children and the offspring of the 'inferior' guardians. (See A.-H.'s note on the present passage.) It is here explained that the meaning is only that these children are not to be brought up as future φύλακες or ἐπίκουροι at the expense of the State, and there is no need to suppose that Socrates in the *Republic* meant more than this. But there is one passage in the *Republic*, not taken into account in the present recapitulation, where something more may be intended. We are told at *Rep.* v. 461 c that 'when the male and female

guardians have passed beyond the age of procreation', i.e. the age during which they can be called on to procreate for the city, they may form voluntary unions on the condition that 'no offspring sees the light', or that if there is issue, there is to be no τροφή for it. This case is not covered by the language of the *Timaeus* about the children of the 'inferior' parents, and A.-H. is not justified in ignoring it in his attempt to show that infanticide is nowhere permitted in the *Republic*. But since the 'age of procreation' was to last until fifty-five for a man and forty for a woman, it is very unlikely that these voluntary unions, which are manifestly intended to provide a little comfort for the guardians in the 'evening of life', would produce any offspring to be exposed. The law would enjoin exposure in certain cases, but in practice the cases would be most unlikely to occur. We are not justified in saying that if the improbable did happen, Plato would treat it in the spirit of modern humanitarianism. In the *Laws*, where Plato's scheme of 'peasant-proprietorship' makes it vitally necessary to keep the number of households constant, it is tacitly assumed that one son and one daughter will be the normal family, departures from the norm being cancelled out by adoptions; nothing is said which even remotely hints at 'exposure'. Plato speaks only of creating a strong moral sentiment against reckless breeding. This seems to indicate that he did not count on infanticide as a regular social remedy for over-population, though it hardly proves that he would have condemned it in exceptional cases. It points in the same direction that, as is well known, Aristotle in the *Politics*, though he allows abortion in the early stages of pregnancy, wholly forbids infanticide.

Whether the practice of 'exposure' of 'unwanted' children really existed to any appreciable extent at Athens is not easy to say. But for what I believe to be the correct view, that it did not, I may refer to the able discussion of Mr. H. Bolkestein *Journal of Classical Philology* Vol. xvii, no. 3. I would add that the existence of a law requiring the successor of a man who leaves no son to portion the daughters of the family, which we can see from the orations of Isaeus and others to have been a very burdensome obligation, tells in the same sense.

19 b–e. Note that Plato is clearly conscious and represents Socrates as conscious of the latter's limitations. Socrates, with all his genius, is after all an *idéologue*. He has no adequate experience of the actual work of the soldier or the statesman, and this is why he cannot make the figures in his picture of an ideal state 'live and move'. He had already shown himself a good fighting-man at Potidaea, Delium, and Amphipolis, but to be a good fighting-man is not necessarily to understand the arts of the soldier or the diplomatist. Of civil administration he had known as good as nothing. (Cp. *Apology* 31 c 4 ff, 32 a 9, *Rep.* 496 c.) The admission that the speculations of the *Republic* are, after all, those of a *doctrinaire* is very significant. Proclus appositely quotes Plato's own language about his visit to the court of Syracuse in 367, *Epp.* vii. 328 c *ταύτῃ μὲν δὴ τῇ διανοίᾳ τε καὶ τόλμῃ ἀπῆρα οἴκοθεν . . . αἰσχυνόμενος μὲν ἐμαυτὸν τὸ μέγιστον μὴ δόξαιμί ποτε ἐμαυτῷ παντάπασι λόγος μόνον ἀτεχνῶς εἶναί τις, ἔργου δὲ οὐδενὸς ἂν ποτε ἐκὼν ἀνθάψασθαι.*

19 c 6. **κατά τε τὰς ἐν τοῖς ἔργοις πράξεις καὶ κατὰ τὰς ἐν τοῖς λόγοις**

διερμηνεύσεις, i. e. 'in feats of arms and in diplomacy'; the latter was as much a part of the functions of an Athenian στρατηγός as the former.

19 e 2. μιμεῖσθαι. Proclus takes this *passive*, to get the forced sense that the poets can narrate the *deeds* of a true hero but cannot catch his ἦθος, and so make him speak 'in character', just as the writers of ἀπολογίαι of Socrates could relate the facts about his trial but, except in the case of Plato, could not breathe his spirit into their λόγοι. I fear this is mere misinterpretation.

19 e 5. ἄστοχον ἅμα φιλοσόφων ἀνδρῶν ἢ καὶ πολιτικῶν. The ἅμα owes its position to hyperbaton, the sense being ἄστοχον ἀνδρῶν φιλοσόφων ἅμα καὶ πολιτικῶν, 'unfamiliar with men who combine science with practical ability', a remote allusion to the qualifications of the philosopher-king.

20 a 2. εὐνομωτάτης. The εὐνομία of the Western Locri was traditional. Cf. Pindar *Olymp.* x. 13 (for the victory of Hagesidamus of Locri in the boys' boxing-match) νέμει γὰρ Ἀτρέκεια πόλιν | Λοκρῶν Ζεφυρίων, 'unswerving Justice makes her home in the city of the Locrians of the West'. The allusion is commonly taken to be to the famous stringency of the laws of the sixth-century Locrian νομοθέτης Zaleucus. I suspect, however, that both Plato and Pindar mean something more. Plato's statement about the eminent magistracies held by Timaeus seems to imply that Locri was one of the cities actually governed by the Pythagoreans before the troubles which broke up the Order in the middle of the fifth century. If this is so, the 'rule of the saints' might be in full swing at Locri in 476, the year in which Pindar's hero Hagesidamus won his victory. I suggest that it is this actual contemporary 'rule of the godly party' to which Pindar is referring. The family of Hagesidamus would be among the dominant 'godly'. This would also give point to the concluding words of *Olymp.* xi, where Pindar, commemorating the same victory, compliments the Locrians on their 'wisdom' as well as on the valour they had just shown by defeating the 'tyrant' Anaxilas of Rhegium. He calls them a στρατὸς ἀκρόσοφος, exactly as Timaeus is said here to have arrived ἐπ' ἀκρὸν φιλοσοφίας ἀπάσης, because the direction of their affairs was in the hands of σοφοί, 'men of science'. (The commentators on Pindar appear to suppose that he means no more than that poetry—poets are constantly called σοφοί—as well as feats of arms was cultivated among them. But as this might have been said of most Greek πόλεις, the point of the compliment is blunted by such an interpretation.)

20 a 6. Κριτίαν . . . λέγομεν. These words are of themselves enough to show that the Critias of the dialogue has a long career of eminence behind him and is known to all Athenians at once as a public man and a σοφός. This would not be true of Critias ὁ τῶν τριάκοντα, whose public career seems to have *begun* in 411. The youth of Hermocrates explains why he remains silent throughout the dialogue. Proclus saw that his silence is significant, but did not interpret it correctly.

20 e 1. Σόλων. The story about Solon and the Egyptian priest (20 e–25 d) seems to rest on no evidence but Plato's.[1] Critias professes here

[1] Plutarch (*Vit. Solon.* c. 26), relating the story of Solon's travels, says that he learned the story of Atlantis, 'as Plato says', from the Egyptian priests (παρ' ὧν καὶ

to give it as a tale which he had heard long ago from his grandfather, the Critias who is recommended in a still extant fragment of Solon to be more obedient to his father. In the *Critias* (113 b 2) he refers to certain γράμματα, 'family papers', written by Solon as the authority for the story. I see no reason to suppose that the whole narrative is more than a fiction of Plato's own. The historical foundation is probably only the general fact of Solon's travels. (As Herodotus takes him to Lydia, and Lydia under Croesus was closely allied with Egypt under Amasis, it is possible that Solon really did visit Egypt.) Hence I think it waste of time to discuss the question whether the tale of Atlantis is founded on mariners' traditions of the American continent, or on Celtic legends of Tir nan Og or Hy Brasil, or on the still extant geographical evidence of the former existence of a now lost 'Atlantic' continent. It is more likely that Plato had heard the report, to which he refers, that the sea west of the Straits of Gibraltar is muddy and not easily navigable, and built up the whole story on this simple foundation. Among the ancient expositors, as we learn from Proclus, Crantor, the first commentator on the dialogue, regarded the narrative as 'literal fact', ψιλὴ ἱστορία. As Proclus contrasts this view with that of 'others' who took the story as a fiction or an allegory, we may reasonably infer that it was not the concordant tradition of the earlier Academy. The later Platonists favoured an allegorical interpretation. Amelius, the friend and editor of Plotinus, thought that the war of Athens and Atlantis symbolizes the contrasted motions of the planets (the offspring of Atlas) and the 'heaven' of the 'fixed' stars (the ἀπλανές); Origenes supposed that what is symbolized is a conflict between higher and lower 'daemons'; Porphyry and others that the story describes the conflict between souls 'descending to generation' and evil daemons. Iamblichus, Syrianus, Proclus more reasonably held that the 'allegory' must have a more general cosmical interpretation. From Proclus's account it appears that Origenes and Numenius, as well as the great critic Longinus, regarded the *story* itself as a pure fiction.[1] For an account of the wild fancies suggested to modern historians of science by the supposition that the tale embodies a real historical tradition see the very full dissertation in Martin's edition (vol. i, 257–333).

The moral of the story is transparently simple. It is that a small and materially poor community animated by true patriotism and high moral ideals can be more than a match for a populous and wealthy empire with immense material resources but wanting in virtue. The Atlantid kings were extremely rich, had enormous forces and—this is a very charac-

τὸν Ἀτλαντικὸν ἀκούσας λόγον, ὡς Πλάτων φησίν κτλ.). This means that the *Timaeus* and *Critias* were all the evidence known to Plutarch for the tale of Solon's intended poem. We could not be told much more plainly that the whole narrative of Solon's conversation with the priests and his intention of writing the poem about Atlantis are an invention of Plato's fancy. The persistent delusion that Plato's tale rests on a genuine historical tradition has had a great deal to do with the still mischievous notion that Greek science originated in some forgotten oriental wisdom (*EGPh.*[3] 16 *n.* 3).

[1] Proclus feels bound, for the honour of Plato's veracity, to insist that the story is also history. But he says the same thing about the tale of Er the Pamphylian!

teristic Platonic touch—the services of highly-developed engineering science. (All this is told in detail, with special stress on the last-mentioned point, in the fragment of the *Critias*.) They embarked on the quest after *Weltmacht* and met no check until the Athenians 'saved themselves by their energy and the rest of mankind by their example'. The moral is that spiritual force is more than a match for material strength. This is the moral the Greeks learned from their struggle with Darius and Xerxes and embodied in the frieze of the Parthenon. It is likely, as has been often suggested, that Plato is consciously taking the history of the Persian wars and throwing it back into supposed prehistoric days with a free remodelling of the incidents in order to make the moral stand out in stronger relief.

The tale is not really specially relevant to the *Timaeus*. It is meant to prepare the way for the fuller account of the Athenian exploit which was to be given by Critias. Its function is to link the *Timaeus* to the *Critias*. It is the false assumption that the story is a relevant prelude to the *Timaeus* itself that is responsible for the quaint 'allegorical' expositions of the later Platonists.

21 b 2. Κουρεῶτις. On the Apaturia see the *Dictionary of Antiquities*, *sub. voc.* The Κουρεῶτις, the third day of the festival, was the occasion on which children born in the preceding twelve months were presented to and formally recognized by the φρατρίαι of their fathers.

21 c 2. ἐλευθεριώτατον. What is the precise point of this compliment? From the context it would appear that the speaker meant to commend Solon's style, not his matter. The reference cannot well be to the political sentiments expressed in Solon's verse, as there would be no sense in saying that these would have been improved if Solon had made poetical composition the main business of his life. τὸ ἐλευθέριον means what is characteristic of the ἐλεύθερος, the 'free man', and the 'free man' is the opposite not only of the 'slave' of an autocrat, but of the 'journeyman' or 'hack', the βάναυσος. Hence I take the meaning to be that Solon did not, like many famous poets, e. g. Pindar, Simonides, Bacchylides, 'write to order' to gratify the tastes of a patron, but, like a free gentleman, to please himself, and that this was reflected in his style and language. Even a Pindar has to be fulsome in his eulogies of his patron, and, when he writes for a Sicilian patron like Hiero or Theron, he has to 'orphicize' in a way which may not have been wholly sincere. Solon, having no one to please but himself, can say what he likes, and is free to say it *as* he likes. *Le style c'est l'homme* is peculiarly true of him. He disposes freely of all the resources of language at his own pleasure, can be diffuse and ornate or concise and bald just as he chooses. (This is in close accord with one of the explanations of the passage quoted by Proclus from the Platonist Origenes.)

We learn from Proclus that Callimachus and Duris made the remark of Critias that, if Solon had given himself seriously to poetry, he would have been a worthy rival of Homer, a ground for disparaging Plato's judgement in literature. As we can see from the remains still extant, the verdict is an absurd one; Solon really had no considerable poetical endowments. But, as Proclus remarks (*Comment. in Rempubl.* i. 65), the

eulogy is not pronounced by Plato but by the old Critias, and is prompted by his personal feelings. Also, as Proclus rightly adds, all that Critias is really commending is Solon's contempt for the flowery language and 'conceits' of the 'professional' poet.

21 c 6. διὰ τὰς στάσεις: i. e. the troubles which led to the first usurpation of Pisistratus; not the disturbances described in the extant fragments of Solon, since his travels were subsequent to his famous archonship and *νομοθεσία*.

22 a. Later legend professed to know more of the details of Solon's intercourse with the Egyptian priests. Proclus says that he foregathered at Sais with Pateneit, at Heliopolis with Ochaapi, at Sebennytus with Ethemon, Plutarch (*Vit. Solon.* 26) that he 'philosophized' with Psenophis of Heliopolis, and Sonchis of Sais, from whom, 'as Plato says', he learned the story of Atlantis. The only interest of these tales is that they show what is also proved, e. g. by Plutarch's *de Iside et Osiride*, that in Alexandrian and post-Alexandrian times Greek writers knew the meaning of a few Egyptian names.

22 b 2. καὶ τὰ τῶν ἐτῶν . . . ἀριθμεῖν, 'tried to compute the dates by reckoning the years which had *elapsed since the events* of which he spoke' (C. W.).

22 b 4. Ἕλληνες ἀεὶ παῖδές ἐστε. The words are often misunderstood. The meaning is not that the Greek *temperament* is that of the 'eternal child', but that the historical records of the Greek world do not go back to a distant period. This view of the recency of all recorded Greek history is one which Plato held very seriously. In the great digression of the *Theaetetus* he says in similar fashion that it is puerile to be proud of a recorded pedigree which goes back (like, e. g., that of a Spartan king) to Heracles in the twenty-fifth generation, since, in the vast of unrecorded time, every one of us must have had many kings and many beggars in his ancestry (*Theaetet.* 175 a–b). So in the sketch of the early development of society with which *Laws* iii opens, he dwells, as here, on the point that all our historical monuments are very recent, since they must all be later than the last great natural catastrophe. Such a catastrophe destroys all records of the past, and it is many generations before the survivors recover the lost art of writing (*Laws* 676 a 1—677 d). As for the names introduced, Phoroneus, who belongs to the legends of Argos, was said to be the son of the river Inachus, and Niobe was his daughter. Some writers regarded Phoroneus as the 'first man'. Cf. Clem. Alex. *Stromat.* i. 102 (Stählin p. 66), Ἀκουσίλαος γὰρ Φορωνέα πρῶτον ἄνθρωπον γενέσθαι λέγει. Paus. II. 16. 1. St. Augustine, whose main authority for Greek and Roman chronology was Varro, makes him contemporary with Jacob (*de Civitat. Dei* xviii. 3). The 'inundation' in the time of Deucalion is mentioned as being the most recent example of a 'deluge' on a grand scale. St. Augustine relates that Varro dated this event in the reign at Athens of Cranaus, son of Cecrops; Eusebius and Jerome placed it in the reign of Cecrops, which, according to Augustine, makes it contemporary with the wanderings of Israel in the wilderness of Sinai (*de Civitat. Dei* xviii. 10–11). Plato was, of course, right in his belief in the antiquity and continuity of Egyptian culture, but he seems to have over-

estimated the age of the existing monuments. In the *Laws* he speaks of monuments which are actually ten thousand years old (*Laws* ii. 656 e 4). Hence the assumption that the Egyptians might possess contemporary records of events nine thousand years before the time of Solon is in full accord with Plato's own beliefs about the age of the earliest monuments. In point of fact it seems that even the earliest remains discovered by modern excavation only allow us to know something of Egypt about 4500 B. C., i. e. less than four thousand years before Solon. The quiet humour of the Egyptian priest's vaunts of the antiquity and superiority of everything Egyptian is intentional, though the irony has escaped the modern commentators. It has not escaped Proclus, who appositely quotes Heraclitus' saying *πολυμαθίη νόον οὐ διδάσκει*, and remarks *περιττὸς οὖν μέγα φρονῶν ἐπὶ τούτοις ὁ Αἰγύπτιος*. Herodotus (ii. 143) has a similar story of the way in which the priests at Thebes bragged of their antiquity to Hecataeus.

22 d 6. σῴζει λυόμενος. *λυόμενος* is the only reading that has any real authority, but I find it hard to believe it sound. We have a choice of two renderings. (1) The word may be taken passively, as by Porphyry (whom A.-H. follows), 'being released', 'being set free'. But from *what* is the Nile 'set free' in times of exceptional drought? According to Porphyry and A.-H., 'from its subterranean fountains'. But there is no apparent reason why the Nile should be set free more copiously from such fountains in a time of drought and heat than at other seasons. It is left unexplained *why* the 'conflagration' does not dry up the Nile as it does other streams. (2) *λυόμενος might* be regarded as middle = 'procuring our deliverance', as by most of the interpreters. The objections are (*a*) that this makes the word a mere equivalent to *σῴζει*, (*b*) that strictly the meaning of the middle participle would be 'paying our ransom'. But to whom or what can we suppose the ransom paid? The *ῥυόμενος* of F is clearly a mere conjecture of some owner or corrector of a manuscript who wanted to get rid of the more difficult *λυόμενος*. The word *ῥύεσθαι* is so exclusively poetical that it would be strange even in the poetical prose affected by Timaeus for his lecture, and still stranger in the straightforward narrative of Critias. It is even possible that the author of the 'emendation' took *ῥυόμενος* to be connected with *ῥεῖν*, and to mean 'flowing'. Chalcidius, in his version, says 'meatu irrigno perennique gurgite obiectus arcet exitum', where *meatu irrigno* looks like a version of *λυόμενος*, understood as = 'being released' (unless Chalcidius read *ῥυόμενος*, and fancied that word equivalent to *ῥέων*).

It seems to me that we are dealing with a corruption older than the lost archetype of our extant MSS.,[1] and I should myself like to see C. W.'s suggestion ΑΥΞΟΜΕΝΟΣ, 'waxing in bulk', restored to the text. The correction is palaeographically admirable, and gives the right sense. It may be asked why the Nile is supposed to rise specially high at a time of universal drought. The answer is that it was a standing puzzle in the

[1] In other words, I suggest that the common source of F and A was a MS. provided with marginal variants, and had *λυόμενος* in the text with *ῥυόμενος* in the margin, and that in this case both variants are corruptions. We shall see other examples of what look like double readings of this lost archetype as we proceed.

fifth century that the Nile, alone of rivers, rises higher in summer (see the discussion in Herodotus ii. 19 ff., especially the words of ii. 19 *ἱστορέων αὐτοὺς ἤντινα δύναμιν ἔχει ὁ Νεῖλος τὰ ἔμπαλιν πεφυκέναι τῶν ἄλλων ποταμῶν*). Since the Nile rises in the hot months, it is a natural suggestion that it would behave in the same fashion at a period of 'conflagration'. Apelt actually wishes to read *ὑόμενος*, but it is notorious that very little rain falls in Egypt.

22 e 2–4. The rarity of rain in Egypt was a familiar fact. See Herodotus ii. 13, Euripides *Helena* 1–3 *Νείλου μὲν αἵδε καλλιπάρθενοι ῥοαί, | ὃς ἀντὶ δίας ψακάδος Αἰγύπτου πέδον | λευκῆς τακείσης χιόνος ὑγραίνει γύας.*

23 c 4. ὑπὲρ τὴν μεγίστην φθορὰν ὕδασιν: not the 'deluge' of Deucalion, but a much earlier one. *οὐ τὴν ἐπὶ Δευκαλίωνός φησιν, ἀλλ' ἴσως τινὰ τῶν πρότερον γεγονότων κατακλυσμῶν* (Proclus).

23 c 6. εὐνομωτάτη διαφερόντως. Cf. 24 d 4 *ἔτι μᾶλλον εὐνομούμενοι.* There is probably an allusion to the traditional *εὐνομία* of Sparta. The traditional distinction of Athens was not *εὐνομία*, but *ἰσονομία* (having *equal* legal rights for rich and poor). Critias means the priest to say that the prehistoric Athenians possessed, 'in a more eminent manner', the very virtue supposed in historical times to be peculiarly Spartan.

24 a 1. αὐτὰ τὰ γράμματα. Thus the priest actually professes to have access to *manuscripts* which recorded the victory of the Athenians over the Atlantid kings. It is probably meant that these manuscripts themselves are 9,000 years old. This goes far beyond Plato's own beliefs about the antiquity of Egyptian *monuments*, and can hardly be anything but satirical.

24 a 3. παραδείγματα. Not 'archetypes', but 'samples' (the regular commercial meaning of the word).

24 b 4. ἔτι δὲ . . . δοράτων. Construe *ἔτι δὲ ἡ τῆς ὁπλίσεως αὐτῶν σχέσις ⟨σχέσις ἐστὶν ὁπλίσεως⟩ ἀσπίδων καὶ δοράτων*, 'the fashion of their arming is a fashion of arming with shield and spear' (C. W.).

24 c 1. μέχρι μαντικῆς καὶ ἰατρικῆς, 'right *down* to divination and physic', things which an ordinary Greek city did not regulate at all. In Egypt even such utilitarian matters are systematized by being based on cosmological and theological principles. Nothing whatever is left unregulated, and theology and cosmology are the foundations of all the regulations. For the facts about the 'government control' in Egypt which Plato has in mind, cf. Herodotus ii. 83, where we are told that all *μαντική* is placed by the Egyptians under the protection of certain gods (*ἀνθρώπων μὲν οὐδενὶ προσκέεται ἡ τέχνη, τῶν δὲ θεῶν μετεξετέροισι*); ii. 84, there are no 'general practitioners' in medicine, every medical man being a 'specialist' (*μιῆς νούσου ἕκαστος ἰητρός ἐστι καὶ οὐ πλεόνων*); Plato probably has these statements in his mind. Tr.: 'Then again as to wisdom, you see what attention our land has given to it from the very starting-point; how it has encouraged cosmology, deriving salutary regulations for human life, right down to the rules of divination and physic, from the principles of that divine study, and mastering all the sciences which derive from it.' The grammar of the sentence is rightly explained by Stallbaum, except that he makes the curious slip of taking

ἅπαντα as accus. masc. sing. in agreement with κόσμον. The construction is ὁρᾷς ὅσην ἐπιμέλειαν ὁ νόμος ἐποιήσατο ἀνευρών τε ἅπαντα περὶ τὸν κόσμον μέχρι μαντικῆς καὶ ἰατρικῆς πρὸς ὑγίειαν ἐκ τούτων θείων ὄντων εἰς τὰ ἀνθρώπινα, κτησάμενός τε ὅσα ἄλλα μαθήματα τούτοις ἕπεται.

24 c 6. τὴν εὐκρασίαν τῶν ὡρῶν . . . οἵσοι. The reference is to the supposed salubriousness of the Attic climate, as was rightly seen by Panaetius, though Proclus wrongly tries to explain this away. The thought is that a balanced and 'temperate' climate is favourable to intelligence, while one which is too cold or hot or wet or dry has a bad effect on the intelligence of the inhabitants. Cf. Euripides *Medea* 826 φερβόμενοι | κλεινοτάταν σοφίαν, | αἰεὶ διὰ λαμπροτάτου | βαίνοντες ἁβρῶς αἰθέρος (said of the Athenians). For ὥρα in the sense of *climate*, cf. *Phaedo* 80 c 5 where it is said that 'a corpse will remain uncorrupted, for a long while if death happens when the body is in good condition (ἐάν τις χαριέντως ἔχων τὸ σῶμα τελευτήσῃ, καὶ ἐν τοιαύτῃ ὥρᾳ), where the reference clearly is to the preservation of corpses buried in dry sandy soil, *Philebus* 26 b 1 οὐκοῦν ἐκ τούτων ὧραί τε καὶ ὅσα καλὰ πάντα ἡμῖν γέγονε, where a good 'climate' is given as an example of the Pythagorean doctrine that 'all good things' are a blend (κρᾶσις cf. εὐκρασίαν in the present passage), of limit and unlimited, *Epinomis* 976 a 1 βοήθεια δέ που καὶ αὕτη (sc. ἡ ἰατρική), σχεδὸν ὅσων ὧραι ψύχει καὶ καύματι ἀκαίρῳ . . . λῃζονται τὴν τῶν ζῴων φύσιν; ib. 987 a 2 where it is said that the planets were first discriminated in Egypt or Syria, διὰ τὸ κάλλος τῆς θερινῆς ὥρας.

24 e 4. πορεύσιμον. The meaning is (C. W.) that the Atlantic was formerly navigable because the mud, which was formed by the subsidence of Atlantis, did not then exist, (*not* because the distance from each of the supposed islands to the next was short). Aristotle, rightly cited at this point by Proclus, also mentions the 'mud' outside the pillars of Heracles, *Meteorologica* B. 1, 354ª 22, τὰ δ' ἔξω στηλῶν βραχέα μὲν διὰ τὸν πηλόν (where note that there is a *v. l.* βαθέα for βραχέα). In Ideler's note *in loc.* other references are given from the περίπλους of Scylax, Theophrastus, Avienus, and Iordanis. Presumably the story is ultimately due to Carthaginian seamen. Theophrastus also (*Hist. Plant.* IV. vi. 4) mentions that there are great masses of vegetation in the 'sea beyond the columns of Heracles', from which it would appear that reports of the sargasso had reached the Greeks. The 'islands' of the Atlantis story may have been suggested by similar Carthaginian stories of the Canaries and Cape Verde Islands. Reference to a good map of the Atlantic will show that the comparative shallowness of the sea just west of the Straits of Gibraltar is a genuine fact.

25 a 1. τὴν περὶ τὸν ἀληθινὸν ἐκεῖνον πόντον. The 'real' ocean is the open sea which is assumed to lie beyond the chain of islands just mentioned to the west. For the phrase cf. the language about the 'real surface' of the earth in the myth of the *Phaedo* 109 b ff., where, as here, the assumption is that the Mediterranean basin is a comparatively small depression, a sort of 'swamp'. For the evidence that the main ideas of this myth are Pythagorean, and that it embodies reports of Carthaginian seamen about the African coast, see the notes in Bt.'s edition of the *Phaedo* 108 c 8—113 a 7.

25 a 3. The thought is that the seas known to the Greek world open out into a great ocean (the πέλαγος ὄντως), and that this ocean is ringed round by land which is the real ἤπειρος 'mainland'. It will also be the ὡς ἀληθῶς γῆ of *Phaedo* 109 e. The fancy combines genuine reports of navigators of the North Atlantic with the old Homeric belief in the 'river' Oceanus, which encompasses *our* γῆ.

25 b 1. Λιβύης . . . Τυρρηνίας. The Atlantid kings were overrunning the Mediterranean world from the west. Plato supposes them to have advanced on the south of the Mediterranean to the western frontier of Egypt (the Canobic mouth of the Nile, Herodotus ii. 15), and to central Italy on the north, when the Athenians checked their progress. The actual fact in his mind is that the Persians were masters of Egypt and had brought Thrace within their 'sphere of influence' on the east, and the Carthaginians were threatening to overwhelm Sicily and Italy on the west, when the danger from the 'barbarians' was checked almost simultaneously on both sides by the victories of Salamis and Plataea in the east, and Gelon's overthrow of the Carthaginians at Himera on the west.

25 c 1. It would be interesting to know whether Pitt's famous sentence (Speech at the Guildhall on Lord Mayor's Day, 1805) was directly inspired by the recollection of this passage. As Pitt was an excellent classical scholar, this is far from impossible.

25 c 6. ὑστέρῳ δὲ χρόνῳ κτλ. Not 'after there had been earthquakes', but, as C. W. says, 'there came an extraordinary earthquake and deluge, and in one dreadful twenty-four hours Atlantis vanished . . .'. The earthquake and the deluge are the constituents of one sudden convulsion of nature. This is why the same day and night see the swallowing up of the heroic Athenian soldiery and the subsidence of Atlantis. The combination of the two—a huge tidal wave and an earthquake—is pretty certainly suggested to Plato by the occurrence of the same thing on a lesser scale in his own lifetime. The tidal wave which destroyed the Achaean cities of Helice and Bura in 373 B. C. was accompanied by a violent earthquake. This earthquake is described at length by Pausanias (see Frazer's translation of Pausanias vii. 24, with the details collected in his commentary on the chapter). Aristotle also gives interesting particulars of the event in *Meteorologica* A. 8, 343^{b} 1–4, B. 8, 368^{b} 6. The same combination was seen in the famous Lisbon earthquake of 1755 (see Kant's full description, *Geschichte und Naturbeschreibung der merkwürdigsten Vorfälle des Erdbebens u.s.w.*, *Werke*, ed. Hartenstein, I. 415–45). Proclus rightly refers to this earthquake of 373 B. C., as well as to one which affected Egypt and Bithynia 'shortly before our own time'—i. e. that of A. D. 358—in illustration of Plato.

The 'one day' of awful storm is referred to again, *Critias* 112 a 1, νῦν μὲν γὰρ μία γενομένη νὺξ ὑγρὰ διαφερόντως κτλ. It is added there that this was the last great 'deluge' but one before Deucalion's.

25 d 5. κάρτα βραχέος. The καταβραχεος or καταβραχέος of F and Proclus, and the κατὰ βραχέος of the margin of A are meaningless. We have to choose between the κάρτα βραχέος of A.-H., Bt., and others, and the κάρτα βαθέος of A. The ancient evidence seems to me in favour of βαθέος. Chalcidius clearly read βαθέος, since he has in his

translation '*crasso* dehiscentis insulae limo'. On the other side it might be argued that Aristotle *Meteorologica* 354ᵃ 22 has the words βραχέα μὲν διὰ τὸν πηλόν, and that this may be a reminiscence of our passage. (The *v. l.* βαθέα in Aristotle could be accounted for as an echo of the βαθέος of A here.) But does it give any satisfactory sense to speak of the *mud* as βραχύς? Those who adopt the reading βραχέος apparently think that 'shallow mud' can mean the same thing as 'mud which is only a little way below the surface of the water'[1]. But surely it must mean a layer of mud which has no great depth, and the want of depth would not make the mud more, but less, of an obstacle to navigation. If βραχέος is retained, we must understand that the mud is not deep because the sinking of Atlantis has raised the bed of the sea, so that (*a*) the water is not deep, and (*b*) what there is of it is muddy. But the mere shallowness of itself would hardly be mentioned as the difficulty. Ancient traders did not put to sea in vessels with the draught of a modern 'super-dreadnought'. βαθέος gives a superior sense. The layer of mud is deep, and therefore abundant; *this* is why the navigation presents difficulties. What Aristotle says is not that the 'mud' is βραχύς, but that the water is βραχὺς διὰ τὸν πηλόν. I think, therefore, that Bt. should have kept the βαθέος of A in his text. (May it not be that βραχέος has got into the text of other MSS. from a confused recollection of the statement in the *Meteorologica*?). Here again it is *possible* that βαθέος and βραχέος were both in the archetype.

26 a 1. διὰ χρόνου. Note the insistence on the remoteness of the days in which our Critias had heard the tale as a boy. The 'tyrant' Critias, who figures as a very young man, not more than about twenty at the outside (for he is not even on military service in the year of Potidaea) in the *Charmides*, would be about thirty at the supposed date of the present conversation. A man of thirty does not find that 'he can hardly recall to-day what he was told yesterday' (*infra* b 4), nor is it 'surprising' (θαυμαστόν b 3) that *he* should still remember a striking experience which he had at the age of ten.

26 c 8, 9. μετενεγκόντες ἐπὶ τἀληθές . . . d 2 τοὺς ἀληθινοὺς εἶναι προγόνους ἡμῶν. As usual in Plato, ἀλήθεια and τὸ ἀληθές are used not of the state of a mind which knows true propositions, nor yet of the propositions themselves but of the facts and relations asserted in the true proposition and apprehended by the mind which knows that proposition. Or rather, the distinction between the true proposition and that which it asserts (its 'objective') is not made by Plato. ἀλήθεια denotes both the proposition and its 'objective', as distinguished from the state or attitude or activity of the mind which knows. This latter is γνῶσις or ἐπιστήμη.

[1] Prof. Burnet suggests to me in defence of his βραχέος Virgil's '*tris Eurus ab alto* | in *brevia* et syrtis urget' (*Aeneid* i. 111). This does not seem to me really relevant. *Brevia* here = τὰ βραχέα 'shallows', as Lewis and Short say; Servius explains it by *vadosa* 'places where you can wade'. But the question whether any one could say βραχὺς πηλός in the sense of 'mire with only a few feet of *water* over it' remains where it was, so far as I can see. I may add that βαθέος is further supported by the paraphrase of the passage in Philo [?] *de Incorruptibilitate Mundi* 26 = *de Mundo* 21 ἡ δὲ Ἀτλαντὶς νῆσος . . . δῦσα κατὰ θαλάσσης ἐξαίφνης ἠφανίσθη, γενομένη πέλαγος οὐ πλωτὸν ἀλλὰ βαραθρῶδες.

Here *τἀληθές* = 'history' as distinguished from imaginative fiction (*μῦθος*), and our *ἀληθινοὶ πρόγονοι* are 'our actual historical progenitors'. In d 1 *ὡς ἐκείνην τήνδε οὖσαν, τήνδε* means 'this our city of Athens' and *ἐκείνην* the city of Socrates' *μῦθος*. 'We will translate your imaginary city and citizens of yesterday into historical fact, and localize that city here as our own Athens.' But the *ἐκείνους* of d 2 seems to go with the *following* words, 'and we will identify the citizens of your speculation with those historical ancestors of ours of whom the priest told'. It might be just possible to take *ἐκείνους* with the preceding *τοὺς πολίτας οὓς διενοοῦ*, but the order of the words makes this most unlikely.

26 d 4. ἁρμόσουσι. The next words suggest that *ἁρμόττειν* here *may* = 'fit the *tune*'. Cf. the use of the verb with *ἀριθμοί* as subject and Machon's *λύραν ἐπίτειν' ἕως ἂν ἁρμόσῃ* (L. and S.). The general sense is 'there will be no change of key, if we say that they (the citizens of the model State) are the very identical Athenians who really lived at that remote time.' *αὐτούς* is to be taken together with *τοὺς ἐν τῷ τότε ὄντας χρόνῳ* and = *ipsos*, not *eos*. *ὄντας* seems to have the same emphatic sense that we see in Ionic, e. g. in Herodotus's use of the phrase *ὁ ἐὼν λόγος* for 'the *true* version' of a story, and (in Attic) in e. g. Aristophanes *Frogs* 1052 *πότερον δ' οὐκ ὄντα λόγον τοῦτον περὶ τῆς Φαίδρας ξυνέθηκα;* 'was not the story of Phaedra only too true? Did *I* make it up?'

27 a 4. περὶ φύσεως τοῦ παντὸς . . . πεποιημένον. An allusion to the old fifth-century name of cosmological research of all kinds. Socrates is made in the *Phaedo* to use the name on the day of his death (*Phaedo* 96 a 8). Cf. Plato's own language at *Laws* x. 891 c 1 ff., where the reference is to sixth- and fifth-century men of science generally, *κινδυνεύει γὰρ ὁ λέγων ταῦτα πῦρ καὶ ὕδωρ καὶ γῆν καὶ ἀέρα πρῶτα ἡγεῖσθαι τῶν πάντων εἶναι, καὶ τὴν φύσιν ὀνομάζειν ταῦτα αὐτά, ψυχὴν δὲ ἐκ τούτων ὕστερον . . . ἆρ' οὖν πρὸς Διὸς οἷον πηγήν τινα ἀνοήτου δόξης ἀνηυρήκαμεν ἀνθρώπων ὁπόσοι πώποτε τῶν περὶ φύσεως ἐφήψαντο ζητημάτων;* Timaeus does not incur the censure here pronounced on all the *φυσικοί*, since he is careful to *start* his account of *τὸ πᾶν* with *ψυχή*. We might wonder that the Pythagoreans are not exempted from the sweeping censure of the *Laws*, but the explanation is a simple one. The immortal soul was a central thing in their *religion*; their *science* implied a 'naturalistic' account of the soul. See *EGPh.*[3] 295 ff. We shall find Timaeus himself in the course of his exposition professing a theory of medical psychology which is really quite irreconcilable with his theology and metaphysics. On the meaning of *φύσις* in early scientific writings see particularly *EGPh.*[3] *Appendix*, and the discussions there referred to.

27 b 9. εἴη καλέσαντα Rawack. A *certain* emendation (one of the very few which can be called so in this dialogue) for the *ἐπικαλέσαντα* of A. The *καλέσαντα* of F has arisen from the dropping of *εἴη* in transcription, Y's *ἂν εἴη* by a copyist's or corrector's restoration of the indispensable word in the 'first best' place. Palaeographically the corruption of A—ΕΙΠΙ for ΕΙΗ—is of the easiest kind.

27 c 1–d 4. What has preceded is rather by way of an introduction to the whole work which would have contained *Republic*, *Timaeus*, *Critias* (*Hermocrates*?), and more particularly to the *Critias* than as prolegomena

to the cosmological discourse of Timaeus. The real beginning of the cosmology is made when the role of chief speaker is taken over by Timaeus at 27 c 1, and from this point all pretence of conversation is dropped. We are really listening to an unbroken scientific lecture (a *διατριβή*, to use the technical term of the Hellenistic age). But we must not forget that according to the explanation which has just been given by Critias, the cosmology of the *Timaeus* is meant, in the complete projected work, to be secondary to the 'political' theory of the *Republic* and that dramatic exhibition of the conduct of the ideal 'guardians' in the council-chamber and in the field which was to have been given by Critias. This has been unduly overlooked by interpreters who have found in the *Timaeus* a 'later Platonic philosophy' radically different in its most fundamental principles from that of the *Republic*.

In beginning his discourse *ab Iove* with a prayer Timaeus is following recognized Pythagorean doctrine which made 'follow God' the supreme rule of conduct. Cf. Iamblichus *V. P.* 137[1] (apparently taken from the work of Aristoxenus on Πυθαγορικὰ Ἀποφθέγματα), *ἅπαντα ὅσα περὶ τοῦ πράττειν ἢ μὴ πράττειν διορίζουσιν, ἐστόχασται τῆς πρὸς τὸ θεῖον ὁμολογίας, καὶ ἀρχὴ αὕτη ἐστὶ καὶ βίος ἅπας συντέτακται πρὸς τὸ ἀκολουθεῖν τῷ θεῷ, καὶ ὁ λόγος οὗτος ταύτης ἐστὶ τῆς φιλοσοφίας, ὅτι γελοῖον ποιοῦσιν ἄνθρωποι ἄλλοθέν ποθεν ζητοῦντες τὸ εὖ ἢ παρὰ τῶν θεῶν.* This is a reason for beginning a lecture (which is one of the *πράξεις* of life) with prayer. Plato himself adopts the rule of 'beginning with God', most notably in the *Laws*, where the great address on the principles of morals and jurisprudence imagined to be delivered by the 'law-giver' to the assembled 'settlers' opens at iv. 715 e 7 with the famous sentence *ὁ μὲν δὴ θεός, ὥσπερ καὶ ὁ παλαιὸς λόγος, ἀρχήν τε καὶ τελευτὴν καὶ μέσα τῶν ὄντων ἁπάντων ἔχων, εὐθείᾳ περαίνει κατὰ φύσιν περιπορευόμενος.*

27 d 5—29 d 3. Timaeus begins his discourse with a distinction which it is vital to keep in mind all through, and to which he recurs repeatedly when he enters on a new division of his subject-matter. He wishes it to be made clear from the outset that the whole of his cosmology makes no claim to be regarded as 'exact science'. Properly speaking it is not 'science' but 'myth', not in the sense that it is baseless fiction, but in the sense that it is the nearest approximation which can 'provisionally' be made to exact truth. Cosmology and biology, and 'pure' physics itself for the matter of that, can never, in his or in Plato's opinion, be rigorously 'exact'. You can never arrive at any finality in these studies, as you can in absolutely pure mathematics, because the things they study are incessantly undergoing variation, or, as Timaeus puts it, 'never *are* but are always becoming'. In pure mathematics you get absolute finality and exactitude, just because there is no change or movement or life in the objects you are studying, integers, triangles, ellipses, and the like. They are once for all just what they are, or rather, *time* has not to be taken into account at all in studying them. Consequently they never 'turn out', as things which change or move or grow are always doing, to be

[1] References to this work are throughout given by the *sections* of Nauck's edition of 1884.

more or less than we had supposed them to be, and so we do not need to be perpetually revising and improving on the results we have once reached about them, as Plato rightly held we have to do in all the 'natural' sciences, even the most abstract of them. What Timaeus wants to insist on is that, to use a phrase of Dr. Whitehead's, 'passage' is the fundamental fact about 'Nature'. This is why all natural science is 'provisional', whereas arithmetic, for instance, is 'final', or, to put it in a more complimentary way, it is why natural science is 'progressive' in a sense in which pure mathematics is not. Physical 'laws' are always being revised and 'corrected' in the light of newly-discovered 'facts' or of more accurate measurements of 'facts' which were already familiar. But no proposition of the multiplication table is exposed to any possibility of 'correction' or 'revision'. There is nothing inherently absurd in the suggestion that Newton's gravitation-formula is not absolutely exact but only a 'first approximation'[1], but it *would* be absurd to suggest that 4 may yet turn out to be only a 'close approximation' to the product of 2×2. There is nothing disparaging to the 'natural' sciences in this correct Platonic view. What their results lose in the way of 'finality' they gain in another way in interest.

This correct perception that there is no finality in natural science is one of the things which most markedly distinguish Plato from Aristotle for the better. The account of the world Plato puts into the mouth of Timaeus is in many ways crude, but in its general outlines it is much more like such an account as might be given to-day than Aristotle's scheme of concentric 'spheres' rotating with constant velocity on unchanging axes. Also Plato is careful to make Timaeus remind us many times over that his doctrines are tentative—the best that can be devised in our present state of imperfect acquaintance with the 'facts', but nothing more—whereas Aristotle really believed the mythology of his *de Caelo* to be exact science and the last word of astronomy.[2] Plato was kept right by his clear understanding of the functions of scientific hypothesis. Its business, as the phrase of the Academy went, is *σῴζειν τὰ φαινόμενα*, 'to save the appearances', that is to find a coherent expression which does full justice to the whole of the ascertained 'facts'. Hence, whenever you find novel 'appearances' or errors in the record of familiar

[1] Cf. A. R. Hinks *Astronomy* (Home University Library), p. 130. Seneca expresses the point of view neatly: *Ep. Mor.* vi. 6 (58). 22 'quaecumque videmus aut tangimus, Plato in illis non numerat, quae esse proprie putat. fluunt enim, [et] in adsidua diminutione atque adiectione sunt'.

[2] It is true that Aristotle occasionally speaks in the *de Caelo* of giving the best account permissible in the present state of our acquaintance with the 'facts': cf. B. 287^{b} 34 *ταῖς μὲν οὖν ἀκριβεστέραις ἀνάγκαις ὅταν τις ἐπιτύχῃ, τότε χάριν ἔχειν δεῖ τοῖς εὑρίσκουσι, νῦν δὲ τὸ φαινόμενον ῥητέον*, 292^{a} 14 *περὶ δὴ τούτων ζητεῖν μὲν καλῶς ἔχει καὶ τὴν ἐπὶ πλεῖον σύνεσιν, καίπερ μικρὰς ἔχοντας ἀφορμὰς καὶ τοσαύτην ἀπόστασιν ἀπέχοντας τῶν περὶ αὐτὰ συμβαινόντων· ὅμως δ' ἐκ τῶν τοιούτων θεωροῦσιν οὐδὲν ἄλογον ἂν δόξειεν εἶναι τὸ νῦν ἀπορούμενον*. But this recognition of the possibility of 'progress' is, after all, merely formal. The whole tone of the *de Caelo* makes it patent that Aristotle does not seriously expect future observation to modify his cosmology except in insignificant details. This is because he does not regard the 'matter' of *cosmology* as 'contingent' but as 'necessary'. In biology, where you deal with a 'contingent' matter, the case is rather different.

'appearances', the hypotheses by which you try to do justice to them all need to be modified. Darwin's theory that species are differentiated mainly by the very gradual accumulation of variations with a survival-value was an attempt to do 'justice' to the 'appearances' collected and discussed in the *Origin of Species*. Apparently subsequent observation has shown that the variations which persist in the descendants of a parent organism and so found new species are those which arise 'at a stroke' by mutations which are not gradual but sudden. If this proves to be so, the most characteristic feature of the 'Darwinian hypothesis', the cumulative influence of 'natural selection' in 'evolution', can no longer be retained. This does not destroy the great historical value of Darwin's work as an attempt to do 'justice' to the 'appearances' known to him any more than the downfall of the Ptolemaic astronomy destroyed the value of astronomical work before Copernicus. It is characteristic of Aristotle that there is, so far as I know, only one passage in the whole of his writings where he admits that one of his theories has been based on very scanty acquaintance with facts and may possibly be upset by future observation, and this passage refers to a wholly minor detail of biology (*de Gen. animal.* Γ 760^{b} 30).

Plato's distinction between the objects of exact science and the things which 'become' may remind us of Bergson's theory of the incompetence of the intellect to grasp without distortion anything but the 'lifeless' world of geometrical forms. But there is this important difference. Plato regards 'mythology' as below exact scientific knowledge, not above it. Hence he does not claim, as Bergson seems to do, a 'higher truth' for imaginative fancy. He holds that though we can never reach finality in natural science, it is our business to get as near to it as we can. We must make our method of studying 'that which becomes' as nearly as possible that of strictly rational science. Mathematical physics is what he is dreaming of.

28 a 1. The distinction between that which once for all 'is' and that which 'becomes' is next expressly equated with the distinction between the *intelligible*, which is apprehended by *νόησις μετὰ λόγου* '*thought* conjoined with an account' of its object, and the *sensible* which is apprehended *δόξῃ μετ' αἰσθήσεως* by 'belief' or 'judgement' accompanied by (or founded on) *sensation*. The former includes the Forms (*εἴδη*), of which we shall hear later, and the numbers and figures studied by the pure mathematician, the latter the whole of what is commonly called the real physical world.

It is important to note at once that Plato always regards the physical world as a complex of *sensibles*. He does not think, as many men of science in the nineteenth century did, of the sensible world as a system of 'states of our own mind' or 'states of our nervous system' *caused* by physical realities which are in their own nature imperceptible. The physical world, as he conceives it, is not something 'hidden behind the veil' of sensible 'qualities'. The business of natural science is not to get 'behind' a 'veil' but to give a rational account of the sensible itself, showing the lines of interconnexion between its constituent parts. From Plato's point of view 'sense-data' are the bricks of which the physical

world is made. Later on we shall find him making Timaeus say that the two grand characteristics of any bodily thing are that it is visible (ὁρατόν) and that it is tangible (ἁπτόν). This does not mean that there are no bodies too small for *us* to see and feel. On the contrary, Timaeus holds that all bodies are made of particles too small for our apprehension. But if we had the 'microscopic eye', or if our tactual sensibility were fine enough, we should be able to see and feel these little particles; it is not their own nature but the scale on which our organs of sight and touch are constructed which makes them imperceptible to us. The main point to be grasped is that the *Timaeus* is wholly free from any form of the doctrine which Professor Whitehead calls the 'bifurcation' of nature. In Aristotle we find 'bifurcation' beginning in the distinction between 'substances', which are imperceptible and the 'accidents' of the substances, which are what we perceive. But the very distinction between 'substance' and 'accident' plays no part in the *Naturphilosophie* of Timaeus. The other two more elaborate forms of 'bifurcation' mentioned by Dr. Whitehead (*Concept of Nature*, lect. ii)—the distinction between an unperceived 'Nature as cause' and a perceived 'Nature as effect', and the distinction between 'Nature as she is' and 'Nature as she appears to us'—are absent from both Plato and Aristotle.

The main 'metaphysical distinction' from which we start, then, is that between ὄντα, in the proper sense of the word, ὄντως ὄντα, '*true* ὄντα', and γιγνόμενα. ὄντα are νοητά, apprehended by thought, γιγνόμενα are αἰσθητά, or apprehended by sense. Or, in the more precise language of the present passage, ὄντα are apprehended by 'thought along with λόγος', γιγνόμενα by 'belief along with sensation'. I. e. you cannot see or touch an ὄντως ὄν, such as Justice, '*the* number 2', '*the* general conic', but you can think of it, and, speaking generally, it has a λόγος or 'discourse'. In this phrase λόγος does not mean, what it probably never means in Plato, 'reason', but quite literally 'discourse' or 'statement'. The kind of statement meant is what in Aristotle's language is called λόγος τῆς οὐσίας or λόγος τοῦ τί ἦν εἶναι, the statement which tells you *what* the object is. Thus it is the λόγος of '2' that it is '*the* natural integer which comes next after 1', of the conic that it is *the* 'curve which is met by a straight line in two points'. The point is that you can give a *definition* of a νοητόν. There is, of course, the difficulty that, since all definition is definition of one thing in terms of something else, there must be *some* νοητά, the simplest and most fundamental of all, which are apprehended but are not definable in terms of anything simpler; the 'indefinables' of science. This is fundamental in Aristotle's logic, and Plato faces the problem, though without propounding a positive doctrine about it, in the *Theaetetus* 201 d 8 ff. That conversation, however, is feigned to be held in the last few weeks of Socrates' life, and thus deals with logical difficulties which we may fairly suppose not to have suggested themselves to an astronomer who was an old man more than twenty years earlier. As for the statement that 'what becomes' is apprehended by 'δόξα along with sensation', it is equivalent to saying that the sensible is apprehended by a perceptual *judgement* or by *judgement* based on perception. The use of the word δόξα in this wide sense for a judgement is

characteristic of Plato's later writings. It meets us for the first time in the *Theaetetus*, where δόξα is the generic name for all judgements. In earlier works, e. g. the *Republic* (cf. especially v. 477 ff.), δόξα is contrasted sharply with ἐπιστήμη 'knowledge', and regularly means a judgement, which is not strictly true, but wholly, or partly erroneous (ἐπ' ἄλλῳ ἄρα τέτακται δόξα καὶ ἐπ' ἄλλῳ ἐπιστήμη, *Rep.* 477 b 7; εἰ τὸ ὂν γνωστόν, ἄλλο τι ἂν δοξαστὸν ἢ τὸ ὂν εἴη, ib. 478 b 3). It is because the apprehension of the physical requires sense-perception, and sense-perception is always of the here and now, that all sensible objects are γιγνόμενα, and not ὄντως ὄντα. You only take in what they are 'here' and 'now', and there is no guarantee that they will always and everywhere be found to be just what you find them to be here and now. It is this *empirical* character of sensation, the fact that it is confined to the strictly particular, which is the reason for speaking of all that is sensible as 'always becoming but never quite really being' (ὄντως οὐδέποτε ὄν, 28 a 3). The same point is put rather differently in the *Phaedo*, where we are told that the things our senses perceive are always 'trying' or 'tending' to be what they never exactly succeed in being. E. g. we never actually see two 'things' which are exactly equal in size; if we adopt more precise standards of measurement, two yard-measures, for instance, which we at first pronounced 'equal', turn out to be only 'approximately so'. Socrates expresses this (*Phaedo* 74 d 10) by saying that the thing I see βούλεται εἶναι οἷον ἄλλο τι τῶν ὄντων ἐνδεῖ δέ, 'tries to be like something else but fails'. What I call a 'yard-measure', e. g. 'tries to be' just a yard long, but does not succeed; it only comes very near being just a yard long, is 'a yard long' within a certain 'standard of approximation'.

28 a 4. πᾶν δ' αὖ . . . σχεῖν. Having made our initial distinction between 'being' and 'becoming', we lay it down as a universal principle that nothing ever 'becomes' unless there is a definite *cause* for its 'becoming' (nothing happens without a cause). This Plato takes for granted as an *a priori* principle presupposed by science, just as Kant does. But note that by a 'cause' he does not mean what Kant means in the *K.d.r.V.* when he speaks of discovering laws of causal connexion between appearances (e. g. in the account of the *Schematism of the Categories* and the *Analogies of Experience*). There Kant means by a cause (a 'mechanical' cause, as he often calls it), just what Mill meant in his *Logic*, an *event* which is related to a subsequent event by an invariable law of sequence. This is the only kind of cause which Kant thought it possible for science to discover, though he maintains stoutly that we are also necessitated by reason to *think* of the whole series of 'appearances' or events as the effect, in a different sense, of a cause or causes which are not 'appearances' and therefore not events. We can *think* of such 'noumenal' causes (e. g. God or human free agents), but according to the doctrine of the *K.d.r.V.* we can never have any scientific *proof* of their existence. It is only because there could be no unconditional moral obligation without free agency, and because we are satisfied that we are under unconditional moral obligations that we are entitled to assert that we are ourselves non-phenomenal causes and that there is a supreme non-phenomenal cause of the whole series of events, God. Plato here

means by a 'cause' not an 'antecedent event', but an agent, or, in the technical language of medieval Aristotelianism, an efficient cause. Unlike Kant, he holds that we can be assured on scientific and not merely on 'moral' grounds that there really are such non-phenomenal causes. His doctrine, fully expounded in *Laws* x. 893 ff., is that all change or movement in the physical world can be shown to be produced by souls or minds (ψυχαί). The argument is this: change or movement is of two kinds, (*a*) communicated from without, 'the movement which is able to move other things but not to set itself moving' (ἡ ἕτερα δυναμένη κινεῖν κίνησις, ἑαυτὴν δὲ ἀδυνατοῦσα, loc. cit. 894 b 8), (*b*) spontaneous or internally initiated movement, 'the movement which can set *itself* as well as other things moving' (ἡ αὐτήν τ' ἀεὶ καὶ ἕτερα δυναμένη, ib. 894 b 9). Obviously, he argues, any chain of movements of the first kind must, in the last resort, be started by a movement of the second kind. All communicated motion must be started by a spontaneous movement. Now the only spontaneous movements are those which in ordinary speech we call 'motions' of the ψυχή, thoughts, choices, desires, and the like (τρόποι καὶ ἤθη καὶ βουλήσεις καὶ λογισμοὶ καὶ δόξαι ἀληθεῖς ἐπιμέλειαί τε καὶ μνῆμαι, *Laws* 896 c–d). 'Souls', then, are the originators of all physical movement and change for better or worse, and the true *definition* of ψυχή is that it is 'the movement which can move itself' (ᾧ δὴ ψυχὴ τοὔνομα, τίς τούτου λόγος; ἔχομεν ἄλλον πλὴν τὸν νυνδὴ ῥηθέντα, τὴν δυναμένην αὐτὴν αὑτὴν κινεῖν κίνησιν; loc. cit. 895 e 10). This is Plato's argument for believing both in the immortality of souls and in the government of the world by that perfectly wise and good ψυχή which men call God. It is because the principle of causality, as he understands it, is a principle of *agency* that he makes Timaeus go on at once to illustrate it by reference to the activity of a mechanic or craftsman (δημιουργός). 'That whereof the craftsman keeps his eye on what is always the same and uses such a thing as a model, is beautiful; that whereof the craftsman looks to something that has become, using a model that becomes, is not beautiful.' This illustration explains why in the 'myth' of creation Timaeus speaks all through of God as 'the artificer', and refers repeatedly to the 'model' or 'pattern' which God had before him in His work (the παράδειγμα). The imagery is mythical, but when we come to discuss its philosophical meaning we shall need to remember that, as the tenth book of the *Laws* shows, Plato believed quite seriously that it can be proved by rigidly scientific reasoning that God, the all-good and all-wise ψυχή, exists and that He orders the course of the world. This Theism is no part of the mythical imagery. Interpreters of the *Timaeus* who try to read 'monism' into Plato by identifying the 'artificer' of the dialogue with his 'model' and also with the ψυχή of the world which he 'constructs' simply ignore the theology of the *Laws*. The dialogues, as well as the whole subsequent history of Platonism, become well-nigh unintelligible unless we understand that Plato was neither a 'monist' nor an 'idealist' in the sense which those words have come to bear to-day. Seneca gets the point right when he says of the *formator universi* (*ad Helviam* 8), 'sive ille deus est potens omnium, sive incorporalis ratio ingentium operum artifex, sive divinus spiritus per omnia maxima ac minima aequali

intentione, diffusus, sive fatum est inmutabilis causarum inter se cohaerentium series', where he means the alternatives to stand for the views of Plato, Aristotle, the Stoics, the Epicureans respectively.

28 a 4. ἐξ ἀνάγκης. Here and in a 8 ἐξ ἀνάγκης = 'by a logical necessity', 'as a consequence from true fundamental propositions'. The use of the word here has nothing to do with the very special sense put on ἀνάγκη later on in the dialogue.

28 a 6. πρὸς τὸ κατὰ ταὐτὰ ἔχον βλέπων ἀεί. The ancient commentators disagreed about the grammar of the clause. Atticus took the ἀεὶ with βλέπων, Porphyry (assuming an hyperbaton), with κατὰ ταὐτὰ ἔχον. Proclus prefers Porpyhry's view though he admits the possibility of the other. Platonic usage seems to me definitely in favour of Porphyry; cf. ἀεὶ κατὰ ταὐτὸν ἔχον above.

28 a 8. ἰδέαν καὶ δύναμιν. The words are wholly untechnical, 'form and quality' or 'form and faculty' in the wide Elizabethan sense of the second word. Cf. *Phaedrus* 246 a 2 περὶ δὲ τῆς ἰδέας αὐτῆς (sc. τῆς ψυχῆς) ὧδε λεκτέον, 'this we may say of its figure', introducing the famous comparison of the soul with a charioteer driving a pair of winged horses; ib. d 6 πέφυκεν ἡ πτεροῦ δύναμις τὸ ἐμβριθὲς ἄγειν ἄνω . . ., where ἡ πτεροῦ δύναμις = 'the quality (or function)' of a πτερόν and is a mere periphrasis for τὸ πτερόν, 'it is the nature of a wing to raise the heavy upwards'. The meaning here, then, is simply that all beauty depends on definite and recognizable form; a work of art representing something which itself fluctuates before the inner vision of the artist, something which he cannot envisage as there and finished once for all, and so 'eternal', lifted out of the shifting flux of mutability, is no true work of art. This is intended to suggest the minor premiss and conclusion, 'the sensible world as a whole *is* a true work of art, therefore it is a revelation of 'eternal form'. Before we can make the syllogism we have to give an *explicit* answer to the question whether the sensible world itself is a thing 'which has become' or not. Our principle of causality was enunciated originally about πᾶν τὸ γιγνόμενον, and we cannot bring the sensible world under its scope unless that world is a γιγνόμενον. It has already been implied that ὁ πᾶς οὐρανός is a γιγνόμενον, since we have been told that all αἰσθητά are γιγνόμενα, but for explicit and formal accuracy we require to have it stated that the οὐρανός is an αἰσθητόν.

28 b 2–3. ὁ δὴ πᾶς οὐρανὸς—ἢ κόσμος κτλ. οὐρανός is the older name of the earliest Ionian science, κόσμος appears first in a fragment of Heraclitus [20 Bywater, 30 *Fr. d. Vors.*[3] i, R.P. 35] κόσμον τόνδε τὸν αὐτὸν ἁπάντων οὔτε τις θεῶν οὔτε ἀνθρώπων ἐποίησεν, where it is expressly denied that any one 'made' the κόσμος, 'it always was and is and will be, an ever-living fire kindling by measure and going out by measure' (ἀλλ' ἦν ἀεὶ καὶ ἔστιν καὶ ἔσται πῦρ ἀείζωον, ἁπτόμενον μέτρα καὶ ἀποσβεννύμενον μέτρα). As the tradition was (Diog. Laert. viii. 48) that Pythagoras was the first to call what his predecessors had called the οὐρανός by the name κόσμος, the occurrence of κόσμος in this passage seems to be an indication of Pythagorean influence on the language of Heraclitus, who belongs to the generation after Pythagoras and mentions him unfavourably as an instance of the difference between πολυμαθίη, 'knowledge of many

things', and *νόος*, 'sense', 'true wisdom' (Fr. 16 Bywater, 40 *Fr. d. Vors.*[3] i, R. P. 31). The word seems to have been felt as unfamiliar in this sense at Athens even well on in the fourth century, since Xenophon half apologizes for using it (*Mem.* i. 1, 11 *ὁ καλούμενος ὑπὸ τῶν σοφιστῶν*, sc. the 'scientists', *κόσμος*).

Apparently, as Bt. has said, the oldest meaning of the word is the ordered 'battle-array' of an army, a sense found in Homer, hence the epithet of the Atridae *κοσμήτορε λαῶν*, 'marshals of the folk'. Then it comes to mean any ordered arrangement, e. g. feminine adornments (cf. in English 'silks and fine *array*'), and metaphorically 'order', 'decency', visible or spiritual. The Pythagorean use of it as = *οὐρανός* is an expression of the idea of the 'reign of law', the same thought which underlies Kant's famous association of the 'starry heaven above' with the 'moral law within'.

In the *Timaeus* and in Plato generally *οὐρανός* or *κόσμος* = the whole physical 'universe'. This is because Timaeus and Plato himself hold that there is only *one* *οὐρανός*. But most of the earlier physicists, perhaps all but Heraclitus[1]—if we exclude the Eleatics who regarded the sensible world as pure illusion—held that there are many, and most of them that there are infinitely many. Thus more exactly the words mean what we might call 'stellar system', a whole complex of earth, sun, moon, planets, and stars (or where the 'stars' are regarded as outside the system to which we belong, the complex of earth, sun, moon, planets). It becomes = our word 'universe' in the mouth of any one who thinks that there is only *one* such complex. (Even to-day astronomers sometimes speak of a plurality of 'universes', thus employing the word precisely in the sense of 'stellar system'.)

28 b 4. τοῦθ' ἡμῖν ὠνομάσθω. The *οὐρανός* is itself a divine thing, a *θεὸς αἰσθητός*, and it is a point of ritual piety to call a god by the name 'acceptable to him'. So Aeschylus in *Agam.* 160 *Ζεύς, ὅστις πότ' ἐστίν, εἰ τόδ' αὐ|τῷ φίλον κεκλημένῳ,* | *τοῦτό νιν προσεννέπω.* Cf. Socrates' playful remark, *Philebus* 12 c 1 *τὸ δ' ἐμὸν δέος, ὦ Πρώταρχε, ἀεὶ πρὸς τὰ τῶν θεῶν ὀνόματα οὐκ ἔστι κατ' ἄνθρωπον, ἀλλὰ πέρα τοῦ μεγίστου φόβου. καὶ νῦν τὴν μὲν Ἀφροδίτην, ὅπῃ ἐκείνῃ φίλον, ταύτῃ προσαγορεύω.*

σκεπτέον δ' οὖν κτλ. Well, had the *οὐρανός*, or whatever else is the most appropriate name for it (Timaeus in the sequel uses both *οὐρανός* and *κόσμος*, but preponderantly the former), a 'beginning of becoming' or had it none? It had, for it can be seen and touched, and is therefore a thing of sense, and all things of sense are *γεννητά* or *γιγνόμενα*. Therefore, since it is a *γιγνόμενον*, it had a cause, it is the work of a *maker* or agent.

This is the really important point. What Plato wishes to insist on is that

[1] Empedocles is another exception, but his position is directly determined by the influence of Parmenides. We may infer from the attitude of Timaeus, as well as from the remains of 'Philolaus', that the later Pythagoreans also believed in the unity of the *οὐρανός*, but we shall see that this was not the original doctrine of the school. The prejudice of later philosophy against 'plurality of worlds' is in the end due to the *Timaeus* itself, with which Aristotle agreed on the point, in spite of the strong Ionic strain in his thought.

the 'world' is not self-subsisting; it is something dependent and derivative, as contrasted with its uncaused and self-subsisting author, God. (The antitheistic retort that if everything has a cause, God must also have one is excluded by the way in which T. formulates his principle of causality. It is only of *γιγνόμενα* that he asserts the necessity for a cause, and God is not a *γιγνόμενον*.) It is not necessary to the argument that the world should have had a beginning 'in time', in the sense that there was a time when the world was not there. All that Timaeus commits himself to by saying that the world is a *γεννητόν* is that 'passage' is a fundamental character of it. Aristotle, on the other hand, maintains the 'eternity of the world' not in the sense that 'becoming' is not derivative (the most important argument of his *Metaphysics*, that of Λ. chs. 6–10, aims at demonstrating that all the motions in the universe depend on the existence of unmoved 'first movers'), but in the different sense that the regular astronomical movements have no beginning and will have no end, and go on with absolute uniformity.[1] This is merely false science, and nothing did more to hinder the acceptance of Galileo's astronomical discoveries than the established prejudice in favour of this Aristotelian mythology of the 'unchanging heavens'. Whether Plato believed or meant to make Timaeus express a belief in a 'beginning of the world in time' has been a hotly disputed question. That he did not mean to say that there was ever a time when the world did not exist is plain from the express words of 38 b 6 *χρόνος μετ' οὐρανοῦ γέγονεν*. But it is possible to believe in a beginning of the world without believing in the absurdity of an empty time when nothing was happening. One might hold simply that there was a 'first moment' of time and that the very 'first event' in the world's history occurred at that first moment. Whether the *Timaeus* teaches a view of this kind cannot be decided by a direct appeal to the text. We have to appeal to the Academic tradition. Now Xenocrates, the second head of the Academy after Plato's death, a contemporary of Aristotle, expressly explained that Plato does not mean to teach that there ever was a 'first moment'. When he speaks of time and the *οὐρανός* as 'beginning', he does so *διδασκαλίας χάριν*, 'as a help to the exposition', just as geometers are perpetually talking of 'joining the points *A* and *B*', 'describing a square on the base *EF*', and so forth, though they know all the time that we can neither make nor unmake a true geometrical line or figure. Our talk of 'drawing' the line or 'describing' the square is only a convenient way of calling a pupil's (or reader's) attention to the fact that, in virtue of our initial postulates, the line or square is already there. This view was also held, as Proclus tells us in commenting on the present passage, by Crantor (*c.* 300), an eminent pupil of Xenocrates, who wrote the first formal commentary on our dialogue. Cf. Plutarch *de animae procreatione in Timaeo Platonis* 1013 a, where Plutarch says

[1] For the arguments on this point see *de Caelo* A. chs. 10–12 (279^b 4–283^b 22). The formal statement is given in the opening words of the following book, *de Caelo* B. 283^b 26 ff. *ὅτι μὲν οὖν οὔτε γέγονεν ὁ πᾶς οὐρανὸς οὔτ' ἐνδέχεται φθαρῆναι, καθάπερ τινές φασιν αὐτόν, ἀλλ' ἔστιν εἷς καὶ ἀΐδιος, ἀρχὴν μὲν καὶ τελευτὴν οὐκ ἔχων . . . ἔχων δὲ καὶ περιέχων ἐν αὑτῷ τὸν ἄπειρον χρόνον, ἔκ τε τῶν εἰρημένων ἔξεστι λαμβάνειν τὴν πίστιν κτλ.*

that 'all these', the followers both of Xenocrates and of Crantor, 'think that the soul (sc. of the *οὐρανός*) has no beginning in time' (1013 a *πάντες οὗτοι χρόνῳ μὲν οἴονται τὴν ψυχὴν μὴ γεγονέναι μηδ' εἶναι γενητήν*), a testimony all the more unimpeachable that Plutarch himself maintains the opposite thesis. Apparently this tradition was steadily maintained by almost all the Platonists down to the time of Plotinus (in the third century A.D.). Proclus mentions only two dissentients, Plutarch himself and Atticus, an acute and learned Platonist of the age of the Antonines. It is true that he speaks of *ἄλλοι πολλοὶ τῶν Πλατωνικῶν* who agreed with Plutarch and Atticus, but, as he gives no other names, we may fairly infer that Plutarch and Atticus were the first Platonists to find a 'beginning of the world in time' in the dialogue. The so-called Neo-Platonists, from Plotinus to Proclus himself, all tried to 'reconcile the difference in a higher unity' by maintaining that the *κόσμος* is *γεννητός* in one sense but not in another. As their explanation was, in the words of Proclus, simply that the world is *γεννητός* in the sense that it is a 'complex' (*σύνθετον*) and dependent on something not itself (*ὡς ἄλλων αἰτίων εἰς τὸ εἶναι δεόμενον*), the Neo-Platonists must be reckoned as holding the Xenocratean tradition on the point that the world had no 'beginning in time'.[1]

On the other hand Aristotle, a contemporary of Xenocrates and like

[1] It may be worth while to summarize the subtle discussion of the problem given by Proclus *in loc.* Plato, he says, is not asking whether the *κόσμος* has a *γένεσις* in *every* conceivable sense (including the sense of having a *first moment* of existence), but whether it has a *γένεσις* in *any* sense. If it has a *γένεσις* in *any* sense, it may be called a *γενητόν*. *τὸ ὄντως γιγνόμενόν ἐστι τὸ ἑαυτὸ μὴ γεννῶν ἀλλ' ὑφ' ἑτέρου παραγόμενον* (Diehl i. 280). . . . *τὸ δὲ οὕτω γενητὸν καὶ ἐκ τοῦ μὴ ὄντος* (e nihilo) *εἴποις ἂν προιέναι . . . καὶ τινὰ μὲν ἀρχὴν ἔχει γενέσεως, τὴν ἀπ' ἄλλου τελειουμένην, οὐ τινὰ δὲ ὡς οὐκ ἔχων ἀρχὴν χρόνου τινὸς μερικοῦ* (ib. i. 282). Against the view of Atticus and Plutarch he urges (1) that the reason why the *κόσμος* is *γεννητός* is said to be that it is visible and tangible. But it is also said that it was visible and tangible '*before* the Demiurge set it in order' (30 a 3.). Hence Atticus and Plutarch cannot be right in the distinction between the 'chaos' which is everlasting and the orderly world fashioned out of it by God, which is not. The reasoning of Timaeus applies to both or to neither. (2) Plato also says (52 d 4) that *γένεσις* was *πρὶν οὐρανὸν γενέσθαι*. Again, if the world's Maker is eternal, we must suppose that he is eternally active, and if so, his work is always there. At the same time Proclus rejects the view of Crantor that the world is only *γεννητὸς κατ' ἐπίνοιαν*, or is feigned to be so *σαφηνείας ἕνεκα διδασκαλικῆς*. For Timaeus *infers* the existence of the Maker from the premiss that the world is *γεννητός*, and if the premiss is only a fiction, the Demiurge must be a fiction too. (This is what some modern exegetes seriously maintain, but Proclus knew the *Latus* too well to fall into the mistake.) His final explanation is that the world (1) had no 'beginning in time', (2) nor does Plato mean *only* that it is the effect of a cause, since Timaeus assigns the more special reason for his conclusion that the *κόσμος* is a *sensible* effect. *πῶς οὖν γενητὸν τὸ πᾶν; . . . ὡς ἀεὶ γιγνόμενον ἅμα καὶ γεγενημένον . . . αὐτὸ γὰρ ὅ ἐστι γίγνεται· διότι μὴ γιγνόμενος οὐκ ἔσται* (ib. i. 291) . . . *καὶ γὰρ γέγονεν ὡς γιγνόμενος καὶ ἔστιν ὡς γενητός*. The Stoic scholar Posidonius manifestly agreed with the Academic tradition. For (1) we should have been informed by Proclus if so eminent a name had been found on the other side; (2) the interpretation of the passage about the *γένεσις* of the world's *ψυχή* given by Posidonius is only intelligible on the view that the 'beginning' is not to be taken as a literal 'beginning in time'; (3) the commentary of Chalcidius, which is dependent on Stoic sources, expressly repudiates the view that the world 'began in time'. Cf. Chalc. *Comment.* 23 (ed. Wrobel p. 89) Et mundus sensibilis opus dei. Origo igitur eius causativa, non temporaria. Sic mundus sensilis, licet coporeus, a deo tamen factus atque institutus, aeternus est.

him a personal disciple of Plato, roundly speaks of Plato as teaching in the *Timaeus* that the world 'had a beginning' but will have no end. (*de Caelo* A. 10, 280 a 28 *εἰσὶ γάρ τινες οἷς ἐνδέχεσθαι δοκεῖ καὶ ἀγένητόν τι ὂν φθαρῆναι καὶ γενόμενον ἄφθαρτον διατελεῖν, ὥσπερ ἐν τῷ* Τιμαίῳ. Cf. ib. 279 b 32 *ἦν δέ τινες βοήθειαν ἐπιχειροῦσι φέρειν ἑαυτοῖς τῶν λεγόντων ἄφθαρτον μὲν εἶναι γενόμενον δέ, οὐκ ἔστιν ἀληθής· ὁμοίως γάρ φασι τοῖς τὰ διαγράμματα γράφουσι καὶ σφᾶς εἰρηκέναι περὶ τῆς γενέσεως, οὐχ ὡς γενομένου ποτέ, ἀλλὰ διδασκαλίας χάριν ὡς μᾶλλον γνωριζόντων, ὥσπερ τὸ διάγραμμα γιγνόμενον θεασαμένους*, a plain allusion to the interpretation of the *Timaeus* given by Xenocrates.) We shall, however, have plenty of opportunity, in considering Aristotle's criticisms on the *Timaeus*, to see that they are not always to be taken *too* seriously. Many of them are mere polemical 'scores' got by pressing the mere words of a sentence. We should probably do Aristotle an injustice if we supposed that he himself took most of his objections to be more than merely verbal points, and some of them appear to be no better than what Simplicius calls them, *σκώμματα* 'japes'. Aristotle's anxiety to make a point against the Academy by professing to understand Plato literally ought not to outweigh the all but unanimous Academic tradition.[1] When we come to deal with the famous paragraph which describes the 'making' of the soul of the world (34 b 10–36 d 7), we shall find that Plutarch and Atticus paid for their deference to Aristotle by getting themselves into inextricable difficulties.

It ought, indeed, to be clear that Xenocrates is right from the simple consideration that after saying expressly that 'time came into being along with the *οὐρανός*' (38 b 6), Timaeus professes to be able to tell us about the state of things 'before' God made the *οὐρανός* (*καὶ πρὶν οὐρανὸν γενέσθαι*, 52 d 4). No sane man could be meant to be understood literally in maintaining at once that time and the world began together, and also that there was a state of things, which he proceeds to describe, *before* there was any world. The 'beginning' of the world at a certain date must be taken to be only part of the mythical imagery; the truth it is intended to convey is simply that the world we perceive by sense depends on a cause other than itself—God.

There is a difficulty about the argument which is not likely to have occurred to Plato, but will readily suggest itself to a modern student. One of the premisses of Timaeus' argument is that the *οὐρανός* itself is *ὁρατὸν καὶ ἁπτόν*, a thing you can touch and see. But is this true?

[1] It is significant that Theophrastus appears to have disagreed with his master's interpretation. Theophrast. *Physic. Opin.* Fr. 11 (*Doxographi* pp. 485–6) *καὶ Θεόφραστος μέντοι ἐν τῷ περὶ τῶν φυσικῶν δοξῶν κατὰ Πλάτωνά φησι γενητὸν τὸν κόσμον καὶ οὕτω ποιεῖται τὰς ἐνστάσεις, παρεμφαίνει δὲ ὅτι ἴσως σαφηνείας χάριν γενητὸν αὐτὸν ὑποτίθεται.* ib. *ὁ δὲ Θεόφραστος εἰπὼν ὅτι "τάχ' ἂν γενητὸν λέγοι σαφηνείας χάριν, ὡς καὶ τοῖς διαγράμμασι παρακολουθοῦμεν γιγνομένοις" φησί· "πλὴν ἴσως ἡ γένεσις οὐχ ὁμοίως ἔχει καὶ ἐπὶ τῶν διαγραμμάτων"*. Theophrastus could not, with decent respect for Aristotle, have made it clearer that he did not personally feel sure of the Aristotelian interpretation. This means all the more because there was a tradition that Theophrastus had been himself a pupil of Plato (Diog. Laert. iii. 46; ib. v. 36 *ἀκούσας Πλάτωνος μετέστη πρὸς Ἀριστοτέλη*). Even if he was not, he necessarily knew men who had been, such as Xenocrates, Aristotle himself, and others.

Every component of the physical world may be a sensible thing, but have we any right to speak of the physical world itself as a whole as if it could be seen and touched? Should we not rather say that the 'physical world' *as a whole* is never an object of perception at all, and that any attempt to reason about it is as though it were 'given' as a single object necessarily leads to fallacy? It will be remembered that this is the whole point of Kant's reasoning in the section of the *KdrV* which aims at exposing the 'antinomies' of the 'pure reason'. The theses and antitheses of the 'antinomies' contradict one another, and yet both appear to be proved by equally irrefragable arguments. Kant's solution of the puzzle is that the same initial false assumption has been made on both sides. It has been assumed that the 'world as a whole' is 'given to us' as an 'object of a possible experience', whereas, in truth, no possible experience can be of the world as a whole, but must be only of some part of it. Now it is true that Kant's reasoning in his comments on the 'antinomies' has been shown to be in its details at least as fallacious as any of the 'sophisms' he professes to expose. (See in particular the brilliant criticism of L. Couturat in *L'Infini mathématique* Pt. II, Bk. IV, ch. 4.) But there does seem to be real force in his main contention that the οὐρανός as a single 'given whole is something with which we have no acquaintance. The same point has been made in Ward's *Naturalism and Agnosticism* against the materialistic philosophy of some eminent men of science, when he points out that we have e.g. no right to talk of the total energy of the whole 'material universe' as if we knew it to be a fixed finite quantum. The argument of Timaeus plainly assumes that in some sense we are acquainted with the whole οὐρανός as a single 'given' object. He says not merely that every object which belongs to it is visible, but that *it* is visible. And this assumption is clearly needed if his syllogism is to be valid. What he wishes to prove is that the οὐρανός is καλόν, that it is a 'work of art', and a work of art, to be recognized as such, must be before us as an individual whole. Unity and individuality are indispensable to its beauty. But is it true that the οὐρανός is ever open to our apprehension as an individual whole? If its volume is finite, as is implied when Timaeus describes it as a sphere and talks of its centre and circumference, we might perhaps understand how he could maintain that at any moment we are really e.g. seeing all there is of it to see, though we see most of it very indistinctly. But what of its admittedly unlimited duration? Can we interpret Leibniz's saying that the present sums up in itself all the past and is big with the whole future in a way which would allow us to hold that, in some sense, at any moment we actually take in the whole context of all space and all time? It is not the business of a commentator on the *Timaeus* to decide whether this is possible or not, but it should be pointed out that the validity of Timaeus' argument depends on the reality of such a possibility. If we adhere strictly to the central doctrine of Kant's *Dialectic*, we are bound to regard the Platonic argument as a 'sophism'.[1]

[1] Perhaps one may just hint that Dr. Whitehead's doctrine of Time (*Concept of Nature* ch. iii) promises to provide us with the point of view we want. Cf. 'The complete general fact, posited as occurring . . . is the discernible. . . . The discernible

28 c 3. τὸν μὲν οὖν ποιητὴν . . . λέγειν. This again has to be understood in the light of the attempt made in *Laws* x to constitute 'natural theology' as a *science*. Plato was quite aware that his own argument for the existence of God based on the dependence of all physical motion on 'soul' was not easy to grasp. Of course he knew that personal religious *faith* in God (such as is displayed by Socrates in the *Apology* and lies at the root of the Pythagorean rule of life) was no new thing. But it is true that God was never made central or even prominent in scientific philosophy until Plato created natural theology. Even Plato himself in earlier dialogues speaks of God only in the language of religious devotion; he does not make God an object of scientific reasoning. Theology as a science begins with the polemic against (*a*) atheism (*b*) the denial of the moral government of the world in *Laws* x. This is why in the second *Epistle* Plato gives Dionysius, who had been teasing him about the subject, nothing but mysterious hints of his meaning (*Ep.* ii. 312 e). He held that his theology should not be carelessly divulged to men who had not the moral and intellectual seriousness to think it out for themselves when the right way was indicated to them.

29 a. The physical world, then, has a 'maker' (cf. ὁ τεκταινόμενος αὐτόν 28 c 6). This means, exactly as the dogma of creation does in Christian theology, that the physical world does not exist in its own right, but depends on a really self-existing being, the 'best ψυχή', God, for its existence. We must ask whether the model before the eye of the Maker was itself 'self-same' and 'eternal' or something that had 'come to be'. Is the 'world' as a whole the embodiment of a definite rational plan or structure, or is its very ground-plan something which, like the successive sensible 'events', is always unfinished and 'provisional'? Is the plan on which the world is constructed, so to say, subject to indefinite revision, like our scientific hypotheses? Perhaps one might say, to revert once more to the instructive parallel with Whitehead's theory, that the question is at bottom whether nature can be regarded as composed solely of 'events' or whether we have also to take into account the 'objects' which are 'situated' in the events. (Cf. *Concept of Nature* ch. 7, p. 143 'objects are elements in nature which do not pass'.) The closeness of the parallel becomes obvious when it is borne in mind that all W.'s 'objects' are 'universals', and that it is only 'objects', as distinguished from 'events' which can be 'recognized' (or, as Plato would say, are 'recalled', ἀναμιμνήσκεται. Cf. op. cit. 144 'events are only comparable

is *all* nature as disclosed in that sense-awareness, and extends beyond and comprises all of nature as actually discriminated or discerned in that awareness' (op. cit. 49–50); 'the disclosure in sense-awareness of the structure of events classifies events into those which are discerned in respect to some further individual character and those which are not otherwise disclosed except as elements of the structure. These signified events must include events in the remote past as well as events in the future. We are *aware* of these as the far-off periods of unbounded time' (ib. p. 52); 'the general fact is the whole simultaneous occurrence of nature which is now for sense-awareness' (ib. p. 53); 'nothing in nature could be what it is except as an ingredient in nature as it is. The whole which is present for discrimination is *posited in sense-awareness* as necessary for the discriminated parts' (ib. 141–2). (Italics mine.) A similar view is more or less clearly presupposed by Varisco, *I Massimi Problemi* (E. Tr. *The Great Problems*) chs. ii–iii.

because they body forth permanences. We are comparing objects in events whenever we can say, "There it is again"'). It would be highly instructive to compare W.'s theory of nature with that of Hume in the *Treatise*. The whole point of Hume's exposition of empiricism is that it is a consistent attempt to build up nature out of 'events' *without* 'objects'.[1] Of course, the very assumption that one hypothesis about events can be a more 'likely' story than another, that as we modify a provisional hypothesis we can make it *more* like the truth, implies that the plan which the complex of sensible facts 'bodies forth' is something coherent and definite. If it had itself no fixed character there would be no ground for expecting our successive remodellings of our 'scientific hypotheses' to bring us steadily nearer to a complete understanding of it. The attempt to construct nature with 'events' alone necessarily ends, as Hume proved, in absolute scepticism, and for the very reason which Hume gave, viz. that, *on this view*, 'all our distinct perceptions are distinct existences, and the mind never perceives any real connexion among distinct existences'.

T.'s way of putting his point is to say that the model of which the world is an 'image' (εἰκών) must be self-same and eternal if the maker of the world is good and his work, the world, beautiful—if, in fact, God is a true artist, as it is assumed that He is (ὁ δ' ἄριστος τῶν αἰτίων 29 a 6). The world is the supreme work of art and its author the best of all causes. This is simply another way of reaffirming what Socrates had been made to say in the *Phaedo*, that it is the 'good' which holds the world together, became the reason, in the last resort, why any particular 'collocation' or 'conjunction' exists (the reason why, for example, the earth is at the 'centre', if it really is there), is that it is *best*, though we may not be able to say why it is best, that it should be so. (*Phaedo* 98 a 4 οὐ γὰρ ἄν ποτε αὐτὸν ᾠμην, φάσκοντά γε ὑπὸ νοῦ αὐτὰ κεκοσμῆσθαι, ἄλλην τινὰ αὐτοῖς αἰτίαν ἐπενεγκεῖν ἢ ὅτι βέλτιστον αὐτὰ οὕτως ἔχειν ἐστὶν ὥσπερ ἔχει, 99 c 5 καὶ ὡς ἀληθῶς τὸ ἀγαθὸν καὶ δέον συνδεῖν καὶ συνέχειν οὐδὲν οἴονται.) Plato, like Socrates, holds that we must look to 'what *ought* to be' as the explanation of 'what is'. But there is one all-important point on which his teaching, as given in *Laws* x, goes beyond anything which he has expressly attributed to Socrates. *How* does it come about that 'what is' conforms, even imperfectly, to the standard of what 'ought to be'? Because, according to the *Laws*,—the doctrine is not expressly put forward by Timaeus any more than by Socrates, and may fairly be regarded as definitely Plato's own—'souls' are the real agents which initiate *all* processes, and Plato, like Socrates and Timaeus, holds that every soul always aims at 'what *it* judges to be *good*'. If, then, the world-order is the product of an absolutely good ψυχή, as Plato offers to prove in the *Laws*, that order is what it 'ought to be'. Evil is real, but it only comes into the scheme of things because there are other ψυχαί besides God who are real agents, and these ψυχαί are not perfectly wise and therefore not perfectly good. They mistake what is not really good for good. (*Laws* x. 896 e–897 d.)

[1] And the same thing may be said of the 'absolute phenomenalism' of such more modern writers as Avenarius, Mach, Clifford, Karl Pearson.

29 b 2 ff. We conclude, then, that the 'model' (*παράδειγμα*) on which the physical world is constructed is 'eternal' but that world itself mutable. (This is virtually what Whitehead means when he says in his own terminology that objects are 'ingredient' in events). Accordingly, it will be a rule of method that 'discourses' (*λόγοι*) about the model must be *final* (*μόνιμοι, ἀμετάπτωτοι* b 6); discourses about the mutable copy cannot have this finality, and are therefore not 'exact' (*ἀκριβεῖς*, cf. the *ἀπηκριβωμένους* of c 6), and we must be satisfied by an approximation to finality and exactitude which is as close as we can make it (*ἐὰν μηδενὸς ἧττον παρεχώμεθα εἰκότας, ἀγαπᾶν χρή* c 7). As we should put it, pure logic and mathematics, including the science of motion treated as a branch of pure mathematics, that analysis of the paths of moving points which we call kinematics, are exact science and finality of statement can be reached in them; physics, as an account of the empirically existent, must be content to be progressive and provisional. The reason is that no 'empirical' premisses, no premisses asserting on the authority of our senses that so and so is the fact at a given moment and place, enter into kinematics. It deals simply with the analysis of more complex paths into simpler; it does not assert that any actual particle is actually describing any of these paths. Its conclusions themselves are all 'formal implications', never assertions of 'fact'. But when you pass from kinematics to physics or even to dynamics, treated as an investigation into the actual motions of actual bodies, you have to introduce 'empirical' premisses, e. g. that such and such a body has this definite velocity, or this definite volume or mass. Now to ascertain an actual velocity or volume or mass, you have to take observations. The accuracy of the observations is dependent on the limits to the discriminative fineness of our senses, and on the delicacy of our 'instruments of precision', and again we have no *absolute* guarantee that observations made under what seem to be identical conditions at different times will always yield identical results, e. g. that the mass of a cubic cm. of iron at a given temperature will always be found to be exactly the same, even 'within the limits of our power of observation'. When all possible precautions have been taken, the measurements of physical magnitudes are necessarily approximate and would remain so even if we had not to allow for the possible modifications of every hypothesis in natural science by the discovery of new 'appearances'. We are dependent for the simplest actual measurements on the evidence of our senses. The senses are not infinitely acute and they only testify to what is given at this or that place and time, and Plato rightly insists on the point.

29 b 2. *μέγιστον δὴ . . . ἀρχήν.* Two constructions are possible and both had supporters in antiquity: (1) *μέγιστον δὴ παντός* may be taken together, 'the chief point in the whole matter is to begin with the true starting-point'; (2) *μέγιστον δή* may be taken as 'it is most important' and *παντός* as depending on *ἄρξασθαι*, 'it is highly important to begin any subject at the right starting-point'. The second construction is followed by Cicero, difficillimum autem est in omni inquisitione rationis exordium, and Proclus. (Chalcidius renders the clause loosely and seems not to recognize the presence of *παντός*, quoniam rationem originis explicare non est facile

factu). The context shows that we are dealing with a general rule of method, hence Proclus is pretty clearly right. *μέγιστον* probably means 'important' rather than 'difficult'.

29 b 5–c 2. τοῦ μὲν οὖν μονίμου . . . ἀνὰ λόγον τε ἐκείνων ὄντας. Bt.'s text is that best authenticated; see his critical note. The grammar is simple when it has been seen that the words *καθ' ὅσον—ἐλλείπειν* are a parenthesis. The construction of the 'accusative absolute' (regular with the participle of *εἶναι*) is continued from the foregoing clause, as is the force of *διοριστέον*. Tr. 'we must lay it down that discourses are akin in character to that which they expound, discourses about the permanent and stable and apprehensible by thought (*μετὰ νοῦ*) themselves permanent and unchanging (so far as it is possible and proper for discourses to be irrefutable and final, there must be no falling short of that—), discourses about that which is itself a likeness likely and corresponding to their objects (*ἐκείνων*)'. The *ἀνικήτοις* of A in b 8 is shown to be more probable than the *ἀκινήτοις* of F by the ancient versions. The *inexpugnabilis* of Chalcidius *might* represent either word (he uses the word again for the *ἀπηκριβωμένους* of c 6), but Cicero's *neque convinci potest* is unambiguous. Here again we may suspect that the common archetype of A and F probably had a marginal variant. Of course we must remember that the warning of Timaeus is meant to apply to the whole of his own cosmology. It is not given as a finally true account of anything but simply as the account which, so far as Timaeus can see, best 'saves', i. e. does full justice to all the 'appearances' so far as they are known to him. Only the purely mathematical and metaphysical principles he propounds lay claim to be more than provisional and tentative. C. W. (*On the Interpretation of Plato's Timaeus* p. 103) maintains that the genitives, *τοῦ μονίμου καὶ βεβαίου καὶ μετὰ νοῦ καταφανοῦς* depend not on *λόγους* but on *ἐξηγητάς* 'understood from the preceding clause'. This seems to me wrong. The *λόγος τοῦ μονίμου* means the discourse which has *τὸ μόνιμον* for its object exactly as the *λόγος τῆς οὐσίας* or *λόγος τοῦ τί ἐστι* means the discourse which tells you what the thing in question is.

29 c 3. ὅτιπερ . . . ἀλήθεια. This clause follows the preceding without a connecting particle, because it is a mere 'epexegesis', resuming the sense of an enunciation but adding nothing to it. (Kühner-Gerth, § 546 e.) Since *πίστις* is said to stand to *ἀλήθεια* as *οὐσία* to *γένεσις*, *πίστις* here must be equivalent to the *δόξα* of *Rep.* 510 a 9 (*ὡς τὸ δοξαστὸν πρὸς τὸ γνωστόν, οὕτω τὸ ὁμοιωθὲν πρὸς τὸ ᾧ ὡμοιώθη.*) It will embrace the *εἰκασία* as well as the *πίστις* of *Rep.* 511 e.

29 c 4–6. πολλὰ πολλῶν πέρι, θεῶν καὶ τῆς τοῦ παντὸς γενέσεως. Bt.'s punctuation and Diehl's *πέρι* for MSS. *περὶ* are clearly right. *πολλῶν* is neuter and *θεῶν* depends on *γενέσεως*. The 'gods' to whom Timaeus really means to refer here are the heavenly bodies, the 'visible gods' of 41 a, and the account of their *γένεσις* is given as part of the story of the *γένεσις* of 'the whole' at 40 a–d. They belong to the sensible world and so it is part of the task of the cosmologist to relate how they 'come to be'. What we can say about them, therefore, is not exact science, any more than the attempts we make to-day to construct a conjectural history of the 'formation of the solar system'.

29 c 8. ἀγαπᾶν χρή. *ἀγαπᾶν* has its usual sense in classical Greek, 'to put up with', 'not to grumble at'. We should prefer exactitude to approximation, and certainties to probabilities, but where the former are not to be had, we must 'put up with', 'be decently contented with' the nearest approximation we can get.

29 d 1. φύσιν ἀνθρωπίνην ἔχομεν. As Timaeus holds that 'from the nature of the subject' there can be no exact knowledge in cosmology, he probably does not mean to suggest that the exactitude he is denying to man is enjoyed by God. If he meant this, we might compare his saying with Leibniz's theory that 'truths of fact' are known by God, though not by man, as analytic propositions because God can complete an infinite logical analysis. But probably he only means that being men and not gods we cannot have all our wishes and it is unreasonable to complain of this. There is a minor uncertainty about the exact rendering of *μηδενὸς ἧττον* in c 7. Is *μηδενός* neuter or masculine? Cicero omits the words; Chalcidius takes *μηδενός* as masc., rendering nihilo minus quam *quivis alius*. Proclus perhaps means to hold the other view, for he comments (Diehl i. 353) *τὸ μηδενὸς ἧττον οὐ μόνον λέγοι ἄν τῶν ἤδη προγεγονότων καὶ θεατῶν τῆς φύσεως ἀλλὰ καὶ αὐτῶν τῶν πραγμάτων τῶν εἰκότων*. A.-H., and apparently Martin, seem to regard the word as neuter. I think the view of Chalcidius the more likely. If *all* cosmological hypotheses are provisional, it is ridiculous to require that an hypothesis should be 'more probable than *everything else*', before it may be entertained. But it is reasonable to stipulate that it shall be at least 'as probable as the alternative proposed by any one else'. Hence I regard *μηδενὸς* as masc. with the familiar 'brachylogy' in comparison. A theory 'not less probable than (the theory) of another' is what is meant.

29 d 5. τὸ μὲν οὖν προοίμιον . . . τὸν δὲ δὴ νόμον. Cf. the better-known use of the same antithesis at *Rep.* 531 d 8, *πάντα ταῦτα προοίμιά ἐστιν αὐτοῦ τοῦ νόμου ὃν δεῖ μαθεῖν*. M. Robin, *La Place de la Physique dans la Philosophie de Platon* 9, n. 2), wishes to take *νόμος* in both places 'in the legislative' sense. This seems a misjudgement. Timaeus is about to sing the high praises of God, not about to draft a code, and the tone of the *Republic* passage is similar.

29 d 7–30 c 1. Why is there a world at all? The problem is not why world should *begin* to be, i. e. why God should wake from an 'eternity of idleness' and set about creating something. The real question is, why should there be anything *except* God, the *ἀρίστη ψυχή*? Why is there a plurality of things? That there actually is such a plurality is assumed, and this should show how wrong it is in principle to find a 'monistic' philosophy of the *ἓν καὶ πᾶν* type in Plato. 'Absolutism' in this sense is not to be found even in the Neo-Platonists. It is characteristic of Plato's later dialogues that the question should be raised. In the *Phaedo* (95 e 9) Socrates finds that he has to raise the general question about the cause of *γένεσις* and *φθορά*. But all Socrates has to say there, is that sensible things come to be what they are because they 'partake of' (*μετέχει*) Forms, or because the Forms 'become present' to them (*πάρεστι*) or 'occupy (*κατέχει*) them'. When the Form 'departs' or 'withdraws' the thing ceases to be what it was. For instance a thing becomes beautiful

(the ugly duckling becomes a handsome swan or the like), when and if the Form Beauty (*αὐτὸ τὸ καλόν*) becomes 'present' to it; if or when the Form 'retires', the once beautiful thing is no longer beautiful. The *Phaedo* hints that this account is not quite satisfactory (100 d 3–8), but it is the best Socrates has to offer. It amounts to saying that what we call a sensible thing is a complex of universal predicates or qualities and that a change in any of these universals makes a change in the whole complex. In fact, if only our knowledge were adequate, we ought to be able to say exactly what a thing is by enumerating the list of its 'qualities' and stating the formula according to which they are combined, as in chemistry we give formulae for the composition of compounds out of their elements. Thus the theory comes to very much the same thing as Lotze's view that a 'thing' is simply 'the law of its states'. (Lotze, *Metaphysik* §§ 32–6. Cf. Burnet, *Greek Philosophy, Thales to Plato* § 126.) Obviously this solution, whatever its other merits, leaves quite unanswered the question *why* the Forms combine by a certain law at one time but not at another. Why, for instance, is the Form of Beauty 'present to' the 'ugly duckling' in June, if it was not 'present' in May? (This is what Lotze is trying to explain by his doctrine that what we call 'things' are all 'actions' of the one 'necessary being'.) Aristotle is thinking of this problem when he complains that the *Phaedo* takes no account of *efficient* causes. (*Met.* A. 991^{a} 8 = M. 1079^{b} 12 *πάντων δὲ μάλιστα διαπορήσειεν ἄν τις τί ποτε συμβάλλεται τὰ εἴδη τοῖς ἀιδίοις τῶν αἰσθητῶν ἢ τοῖς γιγνομένοις καὶ φθειρομένοις. οὔτε γὰρ κινήσεως οὔτε μεταβολῆς οὐδεμιᾶς ἐστὶν αἴτια αὐτοῖς.* *Met.* A. 991^{b} 3 = M. 1080^{a} 2 *ἐν δὲ τῷ Φαίδωνι οὕτω λέγεται, ὡς καὶ τοῦ εἶναι καὶ τοῦ γίγνεσθαι αἴτια τὰ εἴδη ἐστίν· καίτοι τῶν εἰδῶν ὄντων ὅμως οὐ γίγνεται τὰ μετέχοντα, ἐὰν μὴ ᾖ τὸ κινῆσον.* *de Generatione* B. 335^{b} 9 *ἀλλ' οἱ μὲν ἱκανὴν ᾠήθησαν αἰτίαν εἶναι πρὸς τὸ γίνεσθαι τὴν τῶν εἰδῶν φύσιν, ὥσπερ ὁ ἐν Φαίδωνι Σωκράτης, κτλ.*) In the *Phaedo* and *Republic* the only answer suggested is that the Good is the ultimate cause of everything; everything is arranged as it is *best* it should be, the Form of Good is the cause of all being. This is developed further in Plato's later dialogues by means of a doctrine of the soul. We get the first statement of the new development in the *Phaedrus* 245 c–e, where an argument for immortality is given quite different from any of those used in the *Phaedo* and *Republic*. Motion, or change (*κίνησις*), is either communicated to things from without, or spontaneous and originating within the thing which moves. All communicated or derived movement must in the end be originated by something which moves spontaneously from within. Hence that which 'moves itself' must be everlasting, without beginning or end (*οὔτ' ἀπόλλυσθαι οὔτε γίγνεσθαι δυνατόν*). *If* it could cease to be, all movement whatever would come to an end, there would be no more 'events'. Now *ψυχή* is just the Greek name for 'the motion which can move itself', spontaneous activity. Therefore *πᾶσα ψυχὴ ἀθάνατος*, 'every *ψυχή* is immortal'. In *Laws* x. 893 b–899 c the same reasoning is given at much greater length and with more detail, and is used as a proof of the existence and providence of God, the all-wise and all-good *ψυχή*. Since all movement whatever must be originated by something which 'moves itself as well as other things', and *ψυχή* is just the name we give to the

'movement which moves itself', all movement is initiated by the activity of some ψυχή. Consequently what we call 'motions' of the ψυχή, thoughts, wishes, memories, feelings, are the primary causes of all physical change, and the predominance of law in the universe (the 'rhythmical periodicity' of the great cosmic processes) shows that the κόσμος as a whole is under the control of a supreme soul which is perfectly wise and good. This is Plato's reason for believing that God is, that He controls all that happens for wise and good ends, and that He exercises a moral judgement of His creatures 'according to their works'.

In the *Philebus* the same point is made in a rather different way. All that is actual (πάντα τὰ νῦν ὄντα) exhibits the combination or mixture of two elements, (*a*) an Unlimited which is capable of unending continuous increase or decrease, i.e. quality with a continuous range of magnitude (length, volume, degree, intensity, &c.), and (*b*) Limit, mathematical determination. For example, every actual temperature is a *temperature*, and it is a temperature of so many degrees above or below 0° C. The whole indefinite range of possible temperatures ('the hot and cold') is here the 'unlimited' element, since it admits of infinitely numerous variations in two directions; 92, a number, is a 'limit'; the precise temperature which we call 92° C. is a 'mixture of unlimited and limit' (*Philebus* 23 c–26 d). There must further be a cause of every actual combination of unlimited with limit (ἀναγκαῖον . . . πάντα τὰ γιγνόμενα διά τινα αἰτίαν γίγνεσθαι, ib. 26 e 3), and since 'all the good things that come to us' (ὅσα καλὰ πάντα ἡμῖν γέγονε, ib. 26 b 1), health, beauty, wholesome climate, moral excellence, depend on the *right* combination of the two factors, Plato infers that 'mind' (νοῦς) is the cause of this union of the two elements (νοῦς ἐστι γένους τῆς τοῦ πάντων αἰτίου λεχθέντος, ib. 30 e 1). (The *Laws* x. 896 e, enables us to add that not only are wise and good minds the causes of all realization of the right combinations, but bad and foolish minds are the causes of the realization of wrong combinations, disease, unwholesome climate, &c.)

Now, how does this take us beyond the *Phaedo*? In this way. The *Phaedo* had laid it down that the real meaning of the famous formula of Anaxagoras, 'mind set things moving', is that the *good* or *best* is the cause of all the order in the world. But it had been left unsettled by what agency good is thus realized in the order of things. In the later dialogues Plato follows up the thought he had expressed in the *Sophistes* that νοῦς 'mind', 'sense', 'reasonableness' cannot exist except in a ψυχή (*Sophist.* 249 a 4 ἀλλὰ νοῦν μὲν ἔχειν, ζωὴν δὲ μὴ φῶμεν;—καὶ πῶς;—ἀλλὰ ταῦτα μὲν ἀμφότερα ἐνόντ' αὐτῷ λέγομεν, οὐ μὴν ἐν ψυχῇ γε φήσομεν αὐτὸ ἔχειν αὐτά;—καὶ τίν' ἂν ἕτερον ἔχοι τρόπον;) by teaching that in the end *all* that happens is due to the agency of souls and that the supreme soul, God, is perfectly wise, and therefore, in virtue of the Socratic doctrine that virtue is knowledge, perfectly good. Thus in Plato's latest writings, souls, and particularly the supreme soul, God, have an importance for theory which they had not in the *Republic* or any earlier dialogues. It is the activity of soul, acting for the sake of what it believes to be good, by which the actual course of nature is made an approximate, though never a complete, realization of good, an 'imitation' of the perfect order of the Forms.

In the mouth of Timaeus we must not expect to find this natural theology presented, as it is in the *Laws*, in a form which is meant to be 'science'. Natural theology claiming to be science was the creation of Plato himself, and Timaeus was an old man when Plato was born. He speaks the language of religion rather than of 'scientific theology'. He puts the matter in this way. The goodness of God explains both why there is a world at all and why it is a good world. God is perfectly good and φθόνος, the 'grudging' 'dog-in-the-manger', disposition which seeks to engross all that is good for itself is bad and therefore foreign to God. (For the sentiment cf. Socrates' own words at *Phaedrus* 247 a 7 φθόνος γὰρ ἔξω θείου χοροῦ ἵσταται, and for the precise shade of meaning of φθόνος such phrases as Aeschylus *Agam.* 263 κλύοιμ' ἄν εὔφρων· οὐδὲ σιγώσῃ φθόνος, 'but if you keep the news to yourself, I shall feel no *grievance*', and the common colloquial οὐδεὶς φθόνος, e. g. *Phaedo* 61 d 9 ἃ μὲν οὖν τυγχάνω ἀκηκοὼς φθόνος οὐδεὶς λέγειν, 'I shall be only too glad to tell you what I have heard', 'I have no wish to *keep it to myself*'. Timaeus is thinking of the common Greek view that τὸ θεῖον is φθονερόν, 'grudging', in its bestowal of good things.) So just because God is good, He does not keep His blessedness selfishly to Himself. He seeks to make something else as much like Himself in goodness. It is of the very nature of goodness and love to 'overflow'. This is why there is a world, and why, with all its defects, it is 'very good' (cf. Dante, *Paradiso* xiii. 52, Ciò che non more e ciò che può morire | Non è se non splendor di quella idea | Che partorisce, amando, il nostro Sire). The world is not perfect, it is not as good as God Himself but only 'as like Him as may be', (πάντα ὅτι μάλιστα . . . παραπλήσια ἑαυτῷ). This does not mean, as the popular Platonists of the early Roman Empire taught, that 'matter' is the source of evil. The cosmology of Timaeus is a cosmology without 'matter', and Plato teaches expressly in the *Laws* that 'souls' are the real causes of all evil as well as of all good. It means that since the world *is* not God, but something derived from and dependent on God, it cannot be as good as God Himself. If it were, there would be no distinction between God and the world; the world would be just God over again. Plato is no 'Pantheist'. It is because the world is not itself the 'supreme being' but something dependent on the supreme. being that it cannot be wholly perfect, (just as the Neo-Platonists taught that an 'effect' is always less perfect than its 'cause', or as Leibniz said that in every created thing there is an element of 'metaphysical' evil). Plato does not commit himself to any statement about the *amount* of evil in the world, beyond the one general contention that, being the work of an all-good God, the world as a whole must be good, i. e. the evil in it must be subordinate to the good. In the language of the *Laws*, 'disorderly motions' must be subordinate to 'orderly motions'. This leaves us quite at liberty to admit the existence of as much real evil as we please, provided we do not forget that it is 'overcome' by good. Plato is quite free from the tendency of the Stoics or Spinoza to treat evil as an illusion. Partly his intense moral earnestness keeps him from the ethically shallow view that evil is 'only appearance'. Also, not being a 'Pantheist', he has not the motive of the Stoics and Spinoza for minimizing evil. *They*

could not admit that there is any real evil at all in nature without having to deny the perfection of *their* God.[1]

30 a 2–6. βουληθεὶς γὰρ . . . πάντως ἄμεινον. When we are told that God made the world good by taking over 'all that is visible' in a state of confused and disorderly movement and reducing it to law and order, we must not, like Plutarch, imagine that this is to be understood literally as if Plato meant to say that there once was a time when there was mere confusion and chaos, random movement without any 'laws of motion'. Such an interpretation would be absolutely inconsistent with the later emphatic statement that time and the *οὐρανός* 'came into being' together. Plutarch appeals to the fanciful Orphic myth in the *Politicus* where we are told of alternate periods of order and disorder in the life of the *κόσμος*, but we have no right to interpret the *Timaeus* by this myth. The express statements of Timaeus at 33 a 2 that the *οὐρανὸς* was constructed so as to be *ἀγήρως καὶ ἄνοσος*, at 32 c 3 that its body can only be dissolved by him who constructed it (who declares at 41 b that he will never 'dissolve' a single heavenly body), and at 36 e 4 that when the soul of the *κόσμος* had been united to its body it began 'an unceasing and reasonable life for all time' (*θείαν ἀρχὴν ἤρξατο ἀπαύστου καὶ ἔμφρονος βίου πρὸς τὸν σύμπαντα χρόνον*), completely exclude the whole conception of antithetic cycles in which order alternately reaches a maximum and a minimum. On this, as on some other matters, he is not in agreement with Empedocles. Timaeus then cannot be supposed to be seriously teaching the formation of the world from a pre-existing chaos. But it is intelligible that he should use imagery which suggests the notion. Whatever Timaeus or Philolaus might think, the early Pythagoreans started from the Milesian cosmologies of Anaximander and Anaximenes which assumed the plurality of 'worlds' and regarded them as perishable formations derived from a primitive 'boundless' something. We know from Aristotle that they themselves speculated about the process by which an *οὐρανός* is formed (*Met.* N. 1091ª 14 *φανερῶς γὰρ λέγουσιν ὡς τοῦ ἑνὸς συσταθέντος . . . εὐθὺς τὸ ἔγγιστα τοῦ ἀπείρου* [*ὅτι*] *εἵλκετο καὶ ἐπεραίνετο ὑπὸ τοῦ πέρατος*), and that they believed in a 'boundless' which is outside the *κόσμος* (*Physics* Δ. 213ᵇ 22 *εἶναι δ' ἔφασαν καὶ οἱ Πυθαγόρειοι κενόν, καὶ ἐπεισιέναι αὐτὸ τῷ οὐρανῷ ἐκ τοῦ ἀπείρου πνεύματος ὡς ἀναπνέοντι καὶ τὸ κενόν, ὃ διορίζει τὰς φύσεις,*) and from Plutarch that some of them, at least, believed in the 'plurality of worlds' (*de defectu oraculorum* 422 b where we learn that the Pythagorean Petron held that there are just 183 'worlds'). It is therefore natural that though Timaeus himself believes

[1] Yet we must not credit either Timaeus or Plato with a 'finite God', like the deity of J. S. Mill and others, who is supposed to 'do the best he can' for us, but to be hampered by the intractability of a material independent of him and not wholly amenable to his good intentions. There is no trace of this independent 'matter' in the *Timaeus*, and it is expressly excluded in the *Laws* by the doctrine that all 'motions' are originated by *ψυχαί*. The reason why the Creator cannot make a world as good as Himself is that T. holds the view of causality, afterwards elaborated by Neo-Platonists and Schoolmen. An effect, being an 'image', cannot be on the same level as its cause, but must be to it as reflection is to object reflected. It is for much the same reason that the Schoolmen are careful to insist that God's omnipotence does not extend to the power to depose Himself or to decree 'quod Deus non sit Deus'.

in a single *οὐρανός* which lasts all through time, he should continue to employ language which reflects the ideas of the older members of his society, though in a 'Pickwickian' sense of his own. We shall come on other traces of the connexion of Pythagoreanism with Milesian ideas later on. The real meaning, then, would seem to be this. Apart from the activity of God, if *per impossibile* you could 'eliminate God' from the scheme of things, law and order would vanish, you would be left with mere chaotic confusion. So in 30 b Timaeus first speaks as if God began by putting 'rationality' into the world's soul and thus went on to put that soul into a body, as though there had been a body of the world *before* it had a soul and a crazy or irrational soul before the rational soul. But we shall find him afterwards (34 b 10) carefully explaining that this language is not to be taken literally. It would be better to say that body is put into soul, since it is the activities of soul which cause bodily movement, not bodily movement which causes them.

30 b 1–2. οὐδὲν ἀνόητον. The usual meaning of *ἀνόητος* is 'thoughtless', 'silly', but here the word is shown by the context to be used in the exceptional sense of 'mindless'. So at *Phaedo* 80 b 4, where *ἀνοήτῳ* is used as antithetical to *νοητῷ*, there is, as Bt. says in loc. a play on words, the context there requiring the meaning 'unintelligible' rather than 'unintelligent'. The note in the commentary of Olympiodorus on the *Phaedo* (Norvin, p. 161) *ὅτι νοητά ἐστιν ὡς νοητικά· δηλοῖ δὲ τὸ ἀντικείμενον τοῖς γενομένοις ὑπάρχον, τὸ ἀνόητον. εἴρηται δὲ καὶ ἐν Τιμαίῳ ἡ λέξις ἐπὶ τῆσδε τῆς σημασίας* is exactly wrong. It argues that since *ἀνόητον* in both these passages means 'mindless', *νοητῷ* in the *Phaedo* passage must mean 'intelligent', 'thinking'. But really it is *ἀνόητος* itself which Plato is using in a forced sense.

30 b 3. νοῦν δ' αὖ . . . τῳ. Cf. *Sophist.* 249 a 4 *ἀλλὰ νοῦν μὲν ἔχειν, ζωὴν δὲ μὴ φῶμεν;—καὶ πῶς;—ἀλλὰ ταῦτα μὲν ἀμφότερα ἐνόντ' αὐτῷ λέγομεν, οὐ μὴν ἐν ψυχῇ γε φήσομεν αὐτὸ ἔχειν αὐτά;—καὶ τίν' ἂν ἕτερον ἔχοι τρόπον;*

30 c 2–31 b 3. τούτου δ' ὑπάρχοντος . . . καὶ ἔτ' ἔσται. Since the physical world is something which is always 'coming to be', it must, then, be designed after some model (*παράδειγμα*). And since it is a thing which has a *ψυχή* and is alive, the model must also be a *ζῷον* or living creature. But what living creature? Since the various other *ζῷα* are parts of the visible world, which also, as a whole, has a life of its own, the model or type after which it is made cannot be the same as that of any of these, which are only component parts of the whole. As the world is an *αἰσθητὸν ζῷον* which includes all other *αἰσθητὰ ζῷα* (planets, men, beasts, fishes &c.), its model must be a *νοητὸν ζῷον* or 'intelligible living creature' which embraces within itself all the other *νοητὰ ζῷα*, all the other 'types', as parts. This amounts to saying in pictorial phrase that the model or plan which is always being realized but never is finally realized in the visible world is the complete system of the Forms or *εἴδη*. The visible world, in fact, is to this model what a 'circle' which a geometer is drawing with a pair of compasses is to '*the* circle' of which we read in analytical geometry. So Timaeus says that God's model is the *νοητὸν ζῷον*. The complete system of *εἴδη* is a *νοητόν* because it cannot be seen but only

grasped by thought; the eye with which we see it is the eye of the mind, not that of the body. It is a ζῷον because Plato holds that just as there is a soul to my body and another soul to yours, so the whole of *all* body has a corresponding soul. (See the argument on this point in *Philebus* 30 a 3–b 7.) The thought, in its crudest form, goes back to Anaximenes. The ψυχή, 'the breath of life', which a man keeps drawing in so long as he is alive but gives up once for all at death is identified with 'air', the very stuff of which Anaximenes held all the 'worlds' to be made. A 'world in being' makes good all the waste in it by drawing in draughts of the 'boundless air' from without, just as a man keeps himself alive by breathing. The doctrine passed in this crude form into the earliest Pythagoreanism; Aristotle speaks of the Pythagorean view that the world breathes in 'πνεῦμα and void' from the 'boundless' in the passage already quoted from *Physics* Δ. 213^{b} 22 and again in a fragment of his lost monograph on Pythagoreanism (Arist. Fr. 201, τὸν μὲν οὐρανὸν εἶναι ἕνα, ἐπεισάγεσθαι δ' ἐκ τοῦ ἀπείρου χρόνον τε καὶ πνοὴν καὶ τὸ κενὸν ὃ διορίζει ἑκάστων τὰς χώρας, where the reference to 'one' world seems to show that Aristotle is not thinking merely of the *earliest* Pythagoreans). Timaeus is as far removed as Plato himself from the materialistic identification of 'soul' with 'breath', but both are influenced by the old analogy. If it sounds strange to us to speak of the system made up of the Forms as a ζῷον we may remember, perhaps, that the word was used more freely in Attic Greek than 'animal' in English. Any figures in a painting or tapestry, whether they represent 'animals' or not, are called ζῷα and the *vox propria* for a painter (not necessarily an 'animal painter') is ζώγραφος. So in astronomy the ζυγόν or Balance is one of the ζῴδια as much as the Ram or the Bull.

Be careful to note that Timaeus speaks throughout of the νοητὸν ζῷον as something quite distinct from the 'artist' (δημιουργός) who uses it as his model. It has been proposed to regard this distinction as only part of the fanciful imagery of the dialogue. Those who hold this view adopt the interpretation of the Platonic εἴδη which goes back to the Alexandrian Jew Philo, that they are 'thoughts of the divine mind'. This phrase itself is grossly ambiguous. In current language a 'thought' may mean either (1) that which some thinker knows or believes, e. g. 'that all right angles are equal to one another', 'that the battle of Bannockburn was fought on St. John Baptist's day', or (2) the act or process of knowing or believing. The Neo-Philonian interpreters of Plato appear to regard the εἴδη as 'thoughts of God' in sense (2). This interpretation, however, is demonstrably un-Platonic. The only place in Plato where it is even suggested that an εἶδος is a νόημα, a 'notion' or 'thought' which 'takes place' in a ψυχή, is *Parmenides* 132 b 3, where the youthful Socrates desperately suggests that an 'εἶδος is a νόημα and is *in* the soul which thinks it' (μὴ τῶν εἰδῶν ἕκαστον ᾖ τούτων νόημα καὶ οὐδαμοῦ αὐτῷ προσήκῃ ἐγγίγνεσθαι ἄλλοθι ἢ ἐν ψυχαῖς). But the suggestion is at once set aside on the obvious ground that every 'thought' is a thought *about* something, and it is this something which is the εἶδος. That is, the εἶδος is not the 'thought' in the psychologist's sense, but the 'object' of the thought, ὃ ἐπὶ πᾶσιν ἐκεῖνο τὸ νόημα ἐπὸν νοεῖ (ib. 132 c 3). The εἴδη are not the 'thoughts' of any mind,

they are what minds think *about*. And to call the *νοητὸν ζῷον* a 'thought' of God, in the psychologizing sense, would mean in effect that scientific truths, e. g. those of geometry, are only true *because* God thinks they are true, whereas the very application of such predicates as 'omniscient', 'all-wise,' to God implies that God thinks these propositions because they *are* true. God, according to Plato, is a *ψυχή*, and the *εἴδη* are not states or activities of *ψυχαί*, they are the *objects* which *ψυχαί* think of and which they know when they think truly. This does not mean that they are 'supra-sensuous things' like sensible things, but inaccessible to *our* senses. All that is meant is that God thinks truly about them because He thinks of them as they *are*. For example, $3+2$ is not $=5$ because God believes '$3+2=5$'; God thinks '$3+2=5$' because it is true that $3+2=5$, and God thinks only what is true.

We must also beware of the Neo-Platonic interpretation which distinguishes between the Demiurge or 'creator' and the supreme God. The Neo-Platonists identify the supreme God with the principle they call 'the One', i. e. with the Form of Good spoken of in the *Republic*. From the One, according to them, proceeds *νοῦς* and from *νοῦς* proceeds the Soul of the World. These three *ἀρχικαὶ ὑποστάσεις*, the One, *νοῦς*, the Soul of the Whole, form the so-called 'trinity' of Plotinus, and the Neo-Platonists maintained that it is the second member of this series, *νοῦς*, which is meant by the Demiurge, the *νοητὸν ζῷον* being the first member. So far they are right enough, but the assertion that the *νοητὸν ζῷον* is a 'god' superior to the mind which creates the *οὐρανός* is a development for which the dialogues provide no support. God, in the dialogues, is the *ἀρίστη ψυχή*; the *νοητὸν ζῷον* or system of *εἴδη* is not a *ψυχή* at all, and the Demiurge of the *Timaeus* is exactly the 'best *ψυχή*' which is said in the *Laws* to be the source of the great orderly cosmic movements, that is, he is God, and if we are to use the word God in the sense it has in Plato's natural theology, the only God there is.

30 c 6. καθ' ἓν καὶ κατὰ γένη. The meaning seems to be simply 'individually and collectively', i. e. each *νοητὸν ζῷον* and each group or 'family' of *νοητὰ ζῷα* is a member of the *αὐτόζῳον*. If we attempt any further precision of interpretation, we get into apparently insoluble difficulties. Does the *καθ' ἓν* mean that each individual *ζῷον* has its 'model' in the 'intelligible world', so that there is not merely a Form of 'horse', but a Form of Bucephalus and a Form of White Surrey? This would imply that there is a distinct *εἶδος* of every individual thing. This view was definitely held by at least some Neo-Platonists and read into the words before us (Amelius, Theodorus of Asine). But it is hard to reconcile it with the explicit statements of the Platonic dialogues about *εἴδη*, and, harder still, to understand why Aristotle never mentions it if it were really Plato's teaching. His well-known comment, that to account for things by assuming the Forms is like thinking that you make it easier to count a group by adding to its number, would have been made much more forcible if he could have said that Plato in fact 'doubled' everything. Or does *καθ' ἓν* refer to *infimae species*, such as horse, man, *κατὰ γένη* to larger groups, such as mammals, quadrupeds, and the like? This was the view of Atticus, and it seems to me borne out by the fact that Aristotle

does raise the difficulty of the relation of the Form of 'ox', 'horse', and the like to the Form of ζῷον (cf. e.g. *Met.* M. 1085ª 23 *πάντων δὲ κοινὸν τούτων ὅπερ ἐπὶ τῶν εἰδῶν τῶν ὡς γένους συμβαίνει διαπορεῖν, ὅταν τις θῇ τὰ καθόλου, πότερον τὸ ζῷον αὐτὸ ἐν τῷ ζῴῳ ἢ ἕτερον αὐτοῦ ζῴου*). Proclus has a theory to which he alludes more than once (Diehl i. 402, 418, iii. 1) that the *αὐτόζῳον* properly contains just four *ἰδέαι*. He does not make it at all clear what he has in mind, but I suspect that he is reproducing a genuine ancient tradition. Cf. Aristot. *de Anima* A. 404ᵇ 18, where Aristotle, after alluding to the construction of the world-soul in the *Timaeus*, goes on to say that Plato taught 'similarly' in his oral discourses (*ἐν τοῖς περὶ φιλοσοφίας λεγομένοις*, apparently a reference to the famous 'unwritten lecture' about the 'good') that *αὐτὸ μὲν τὸ ζῷον ἐξ αὐτῆς τῆς τοῦ ἑνὸς ἰδέας καὶ τοῦ πρώτου μήκους καὶ πλάτους καὶ βάθους, τὰ δ' ἄλλα ὁμοιοτρόπως*. Complete discussion of this must be postponed until we can comment fully on 35 a ff., but the general meaning seems to be that the *αὐτόζῳον* has solidity or volume, and hence that it contains the elements point, line, surface, solid, which in their turn are derived from the numbers 1, 2, 3, 4, the same which give as their sum 10, and as a series form the original *τετρακτύς* of the Pythagoreans. Aristotle more than once dwells on the point that the Academy also held that the 'numbers which are the Forms' are confined to the *δεκάς* (*Met.* Λ. 1073ª 20 *περὶ δὲ τῶν ἀριθμῶν ὁτὲ μὲν ὡς περὶ ἀπείρων λέγουσι, ὁτὲ δ' ὡς μέχρι τῆς δεκάδος ὡρισμένων*, ib. 1084ª 12 *εἰ μέχρι τῆς δεκάδος ὁ ἀριθμός, ὥσπερ τινές φασιν, πρῶτον μὲν ταχὺ ἐπιλείψει τὰ εἴδη*). This seems to be at the bottom of Proclus' never fully explained statements.

30 c 7–8. τὰ γὰρ δὴ . . . περιλαβὸν ἔχει. Atticus raised the question whether the Demiurge himself is one of the ζῷα contained in the *αὐτόζῳον*. If not, the 'model' does not contain *all* *νοητὰ ζῷα* within itself; if he is, he is himself not *τέλεος*. The Neo-Platonists had various ways of dealing with the difficulty, which may be found recorded in Proclus. If the question is to be raised at all, the answer presumably should be that, since the Demiurge has no body, he is not, speaking strictly, to be called a ζῷον, but simply a *ψυχή*, and further, since a *ψυχή* is not an *εἶδος*, the *ἀρίστη ψυχή* clearly neither is, nor is included, in the system of *εἴδη*. No doubt it might be urged that if, as we are often told by Plato, 'universals' correspond to *εἴδη*, there ought to be an *εἶδος* of *ψυχή*, and the *ἀρίστη ψυχή* ought to 'participate in' or 'imitate' this *εἶδος*. Thus we can understand how a Neo-Platonist like Amelius came to distinguish two Demiurgi, a 'prior' and a 'posterior', and how Proclus was led to still more subtle refinements. But it is idle to read any of these subtleties into the Platonic text.

30 d 2. τῷ γὰρ τῶν νοουμένων καλλίστῳ καὶ κατὰ πάντα τελέῳ. It is simplest to take *τῶν νοουμένων* substantivally, 'the fairest of all objects of thought'. Proclus wishes to take it adjectivally, and to 'understand' *ζῴων* as the substantive to be supplied. This is grammatically possible. We could not, of course, 'supply' the word by anticipation from the following ζῷον, but it might quite well be 'understood' on the strength of the preceding ζῷα of c 7.

31 a 2–b 3. πότερον οὖν . . . ἔτ' ἔσται. Next the question is raised whether

there is only one οὐρανός or many, and possibly infinitely many. The question is a perfectly intelligible one when we remember that an οὐρανός meant to the early cosmologists simply a 'stellar' or planetary system. There was nothing in the *word* οὐρανός or κόσμος, as there is in our word 'universe', to suggest that 'many οὐρανοί' or 'many κόσμοι' is a *contradictio in adiecto*. The reference here, and again at 55 c, to the theory of 'innumerable οὐρανοί' has been supposed to be meant as a criticism of the famous Atomist Democritus. This is more than unlikely. There is no passage anywhere in Plato which shows beyond doubt that he knew of Democritus. If he had known anything about him, he would probably have been attracted by his insistence on the difference between sense-perception and thought (a capital point in Plato's own doctrine), and also by his corpuscular physics, though he would have disapproved of his denial of teleology and divine agency. As for mere allusions to Atomism, if there really are any such allusions in Plato, they do not require to be explained by knowledge of Democritus. The Atomic doctrine had been propounded originally not by Democritus but by Leucippus, who appears to have been a pupil of Parmenides, and thus as old as, or older than Socrates, whom Plato describes as meeting Parmenides when Socrates was 'very young' and Parmenides about sixty-five (*Parm.* 127 b). Moreover, we must remember that the speaker is not Plato but Timaeus. He can hardly be alluding to D., who would be a comparatively young man at the supposed date of the present conversation, and belonged to a very remote part of the Hellenic world. Such resemblances as we shall discover later on between Timaeus and Democritus are most naturally explained by the fact, well known to ancient writers on the history of science, but too much overlooked in modern times, that Democritus himself was strongly influenced by Pythagoreanism. If these are real allusions in the dialogue to Atomism—but the fact is doubtful—this is most readily accounted for by the connexion of Leucippus with the Eleatics (for which cf. Theophrast. *ap.* Simplic. *in Physica* 28, 4, R. P. 185). If Ecphantus, who also taught τὰ μὲν πρῶτα ἀδιαίρετα εἶναι σώματα (*Doxogr. Gr.* 566, R. P. 76 b), is, as Diels held, a figure of the fifth century, T. might know of him. But it is equally possible that he belongs to the fourth-century revival of Pythagoreanism by Archytas and his friends.

The 'innumerable worlds' are not specially connected with Atomism, but are a regular feature of the earliest Greek cosmologies. With the exceptions of Heraclitus, the Eleatics, and Empedocles, all the early 'philosophers' of note appear to have believed in a plurality of 'worlds'. This is, as it is the merit of Bt. to have shown, certainly true of Anaximander, Anaximenes, Anaxagoras (for this last see *EGPh.*[2] 269–70), and, what is still more to the point, we know it to be true of the early Pythagoreans or some of them. As the question was one on which the Pythagoreans themselves had not always been agreed, it is natural that Timaeus should deal with it at the very outset of his exposition. As for Plato himself, the one thing in his writings which looks at all like a reference to Democritus has to do not with science but with religion. It is the fierce attack in *Laws* x. 899 d ff. on the heretics who admit the existence of gods, but deny that they concern themselves with our fate or conduct.

This doctrine was notoriously a grand point with Epicurus, who began his career about forty years after Plato's death, and Epicurus was indebted for his general view of the world to disciples of Democritus, and even for a time called himself a Democritean. Hence it has been suggested that Plato's heretics may be disciples of Democritus. The inference is, however, very precarious. The secular tone to which Plato objects was really characteristic of all the early physicists. The one author whom Plato's language in the *Laws* shows him to have certainly in mind is Empedocles, who is quite definitely alluded to at 889 b 1–2. The denial of providence was indeed no new thing at Athens in Plato's time. Thirty years before his birth Aeschylus had complained (*Agam.* 369) of the same thing (*οὐκ ἔφα τις | θεοὺς βροτῶν ἀξιοῦσθαι μέλειν*), and Xenophon represents Socrates as engaged in polemic with 'free-thinkers' whom no one will suppose to have been 'Democriteans' (*Mem.* i. 4, especially § 11, where the opponent raises the very point, *εἰ νομίζοιμι θεοὺς ἀνθρώπων τι φροντίζειν, οὐκ ἂν ἀμελοίην αὐτῶν*).

As for the doctrine that there is only *one* *οὐρανός*, the earliest writing of first-rate importance in which it is taught, after Heraclitus, is the *Timaeus* itself. Its acceptance by the great majority of later philosophers and men of science is directly due to the influence of the *Timaeus* and of Aristotle, who on this point throws over the Ionian influence which is so marked a feature of his cosmology and follows Plato. The reason formally given by Timaeus is that the model, the *νοητὸν ζῷον*, is one, as it embraces all the types of *ζῷα*, and therefore the copy, the sensible world, must reproduce this characteristic of all-inclusiveness and be *one* also. Why should this prove that there is only one copy of the *νοητὸν ζῷον*, since it might be urged of any Form that it is one and only one, yet the 'copies' of other Forms (Man, Horse, &c.) are indefinitely many? I suppose that what is really meant is that there is thorough-going interconnexion between all the parts that make up 'nature'; whatever is 'sensible' at all stands in definite interconnexion with everything else that is sensible, and thus the complex of 'all the sensible' is a single system. Similarly, though there is not really one single stellar system, as Plato supposed, but many—modern astronomers talk of 'streams' of suns drifting in different directions—still they are all definitely related to one another, and conform to one and the same set of ultimate laws of motion, and thus do form parts of one larger system, the 'universe'. At least when men of science talk about 'laws of nature' they tacitly make this assumption. They would not give that name to a formula which holds true of our particular 'stellar system' if they thought that it very likely does not hold true of others. They do really assume that the *αἰσθητὸν ζῷον* is one because the *νοητὸν ζῷον* is one. 'Radical empiricists' and 'pragmatists' have sometimes urged that this belief is a *petitio principii*. If it is, all science seems to depend on the *petitio*. To deny it would be to break with the most ultimate of all Plato's philosophical convictions, the belief he inherited from Socrates that there is just one single organizing principle at work everywhere,—the 'good'. It is in many ways unfortunate that Plato should have confused the principle of the 'uniformity' of nature with the assertion that there is only one 'stellar system'.

31 a 1. **ζῷα** om. Pr. (ter in comm.) Chalc. [Burnet, critical note.] If this means that Chalcidius does not recognize the word ζῷα here, there is a slight inaccuracy. He does render ζῷα in a 1 by 'Cuncta quae vita fruuntur'. He does, however, omit the ζῷα after *νοητά* in a 5, on which Bt. has no remark.

31 a 4. **τὸ περιέχον.** Note the intentional echo of the vocabulary of the oldest cosmology. The word apparently goes right back to Anaximander who spoke of the 'boundless' out of which the 'worlds' arise, and into which they perish as 'encompassing and steering the course of all things' (Aristot. *Phys.* Γ. 203^{b} 11, R. P. 17, *καὶ περιέχειν ἅπαντα καὶ πάντα κυβερνᾶν*,—the vocabulary suggests that this is an actual quotation, presumably from Anaximander, from whom the word *ἀνώλεθρον* as an epithet of the 'boundless' is cited immediately below). So Anaximenes (Fr. 2, R. P. 24) says of *his* boundless *ἀήρ* that it *ὅλον τὸν κόσμον περιέχει*. The word was originally meant quite literally. The primary 'stuff' out of which the worlds arise is thought of as extending round them indefinitely far in every direction. These echoes of the old Ionian cosmological vocabulary, which will meet us frequently in the *Timaeus*, are manifestly intentional. Plato by no means wishes us to lose sight of the fact that the discourse is put into the mouth of a man of science who belongs to the generation before Socrates.

31 a 6–8. **πάλιν γὰρ . . . ὀρθότερον.** Not an 'argument from the impossibility of the indefinite regress', like that at *Parm.* 132 d 5 ff., since *τόδε* in l. 8 means the *sensible* world. The arguments from the 'regress' seem to have been introduced into philosophy by Zeno the great critic of Pythagoreanism.

31 b 3. **εἷς ὅδε μονογενὴς οὐρανὸς γεγονὼς ἔστιν καὶ ἔτ' ἔσται.** The words should be carefully noted. In the earlier Platonic dialogues (for example, in *Rep.* v) *γένεσις* and *οὐσία* are placed in sharp antithesis to each other, as indeed they are by Timaeus himself at 27 d 6 ff. In the *Philebus* we find a maturer doctrine according to which there is a *positive* relation between them. This comes out first at 26 d 7, where the process by which a definite combination of limit and unlimited is effected is called *γένεσις εἰς οὐσίαν ἐκ τῶν μετὰ τοῦ πέρατος ἀπειργασμένων μέτρων*. It is a *γένεσις* because it is a process, exhibits 'passage', but it ends in the establishment of an *οὐσία*, something with a definite and determinate character of its own. Just in so far as we can detect definite *law* in the sequences of the physical world, just so far as they exhibit definite numerical relations, we can say that they are not mere 'change' or 'variation', but change which leads to a stable 'being'. Consequently a little further on (*Philebus* 27 b 8) the 'mixtures' of the limit and unlimited are actually called *μεικτὴ καὶ γεγενημένη οὐσία*, a phrase which would hardly have been possible to Plato when he wrote of the relations of *γένεσις* and *οὐσία* as he had done in the *Phaedo* and *Republic*. We may illustrate the importance of this conception of *γένεσις εἰς οὐσίαν* by a reference to the part played in modern science by the notion of fixed natural constants or invariants. Water can pass through an indefinite number of changes of temperature, but there is just one *definite* temperature (the 'freezing-point') at which pure distilled water under the pressure

of one atmosphere will freeze at sea-level, and just one other at which it will 'boil'. We might say that the main aim of science is just to detect with maximum accuracy these natural invariants. According to the classical Newtonian mechanics, the 'mass' of a given body is just such an invariant. Recent electro-magnetic theory suggests that mass may after all not be an absolute constant. It then becomes our immediate problem to find something else to take its place as a natural constant. It may be that science will never discover any apparent invariants which subsequent investigation will not show to be only relatively constant. But it is the business of science every time we find our old constants turning out to be variable to look for new ones which are less variable. That we can never be sure that we have found absolute physical constants is just what is meant by saying that nature is a γένεσις; that at each failure of the old ones we find new ones which are less variable is what is meant by saying that it is a γένεσις εἰς οὐσίαν. It is this doctrine of γένεσις εἰς οὐσίαν which explains why Timaeus here says that the world of nature 'having come to be is and still shall be'. Strictly speaking, the whole conception is not quite in accord with the sharp antithesis Timaeus began by drawing between 'that which always is and never exhibits γένεσις' and 'that which becomes but never is'. Formally he has taken his starting-point from the doctrine of the *Phaedo*, as is natural when we remember that the *Phaedo* is, as Bt. has said, virtually dedicated to the Pythagoreans of Phlius, and that Timaeus is a fifth-century Pythagorean. One may doubt whether any actual Pythagorean of the fifth century would have used a phrase which really implies the doctrines of the *Philebus*, though we should be careful to remember that the *Philebus* too is based on Pythagorean ideas, and that Socrates is the speaker there. We can hardly doubt that the clear conception of a γεγενημένη οὐσία is a result of Plato's own personal thought; Timaeus is not allowed to explain, but only to imply it.

The accentuation ἔστιν is clearly right. The late Dr. Adam, in his pamphlet on the *Nuptial Number of Plato*,[1] gives an interpretation which requires us to read γεγονώς ἐστιν and to construe γεγονώς ἐστι καὶ ἔτι ἔσται γεγονώς, 'has come into being and shall hereafter come into being again'. The object of this decidedly harsh way of taking the words is to get the doctrine of the alternate creation and dissolution of the οὐρανός into the *Timaeus*. Some Pythagoreans held the theory, according to the curious passage of Eudemus given at R. P. 84, on the authority of the commentary of Simplicius on the *Physics* of Aristotle. But we have already seen that Timaeus expressly denies it.

[1] *The Nuptial Number of Plato* p. 68 n. 2, where the words are quoted with ἐστί τε for the correct reading ἔστιν, and rendered 'has been born and shall be born hereafter'. (We have no right to retain the τε against the consensus of A and F, and, with it or without it, the preceding word should be ἔστι, not ἐστί.) In the important *Appendix* to Bk. VIII of the *Republic*, in which Dr. Adam gives his final views about the famous 'number', the reference to our passage has been, rightly, removed. We must not misinterpret what is said e.g. at *Laws* iii. 676–7 about recurrent *local* floods and fires which cause breaks in the history of human civilization as though it had anything to do with the notion of alternate cosmical cycles. The myth related 'in play' (παιδιᾶν ἐγκερασαμένους, *Politicus* 268 d 8) by the 'Eleatic stranger' must not be taken as part of Plato's own 'philosophy'.

31 b 4–32 c 3. σωματοειδὲς δὲ . . . ὑπὸ τοῦ συνδήσαντος γενέσθαι. 'Nature' is corporeal; bodies are visible and tangible. If they are to be visible there must be *fire*, if they are to be tangible, they must be solid (i. e. must offer resistance to touch), and therefore there must be *earth*. So there are fire and earth in the composition of the οὐρανός. But fire and earth are the two end terms of a series between which there are two intermediaries, air and water. These two intermediaries then must also be real if the 'opposites' fire and earth are to be wrought into stable compounds. Thus we arrive at the familiar 'four roots' of Empedocles as a first rough analysis of the components of body. Timaeus reveals himself thus early in his narrative as aiming at a contamination of Pythagorean mathematics with Empedoclean chemistry and biology. Empedocles had been content to treat the existence of just these four roots and no more as an obvious fact; Timaeus, in the true Pythagorean spirit, offers us a mathematical or quasi-mathematical reason why there should be four of them and why there should be just the four there are. Before we consider the details of his statement, it is necessary to make some comments of a more general nature. (1) Note that we are offered a mere rough preliminary account. Later on (53 c 4 ff.) Timaeus proposes a much more thorough analysis of bodies based on the geometrical structure of their corpuscles (thus getting back from Empedocles to Pythagoreanism). The Empedoclean classification is given merely as a first approximation. Timaeus himself is so far from regarding the four 'roots' as final that he says expressly that, so far from being στοιχεῖα, *elementa*, the ABC of nature, the four roots do not even deserve to be called 'syllables' (48 b 8). Here Plato shows much profounder insight than Aristotle, who argues at great length in the *de Generatione* that, for very bad *a priori* reasons, the simplest actual bodies must be just the Empedoclean four, and raises difficulties about the further mathematical analysis of their corpuscles. (2) Of course it is Timaeus and not Plato who is speaking, and it is *historically* right that Timaeus should take the four 'roots' of Empedocles as the starting-point for his theory. See particularly *EGPh.*[3] 292 ff., where it is shown that the key to understanding the Pythagoreanism of the later fifth century is to be found in the fact that the Pythagoreans of that age accepted, in their main outlines, the medical and physiological doctrines of Empedocles and the Sicilian medical school, and were therefore anxious to bring his four 'roots' into connexion with their own traditional analysis of things into limit and the unlimited. This is why Timaeus begins by adopting Empedocles' classification of bodies, but later on offers a theory of the geometrical structure of the 'roots' which makes each of them an example of the combination of πέρας and ἄπειρον. All this does not commit Plato himself to more than a general approval of the lines on which the doctrine is worked out, though, since he held that cosmology is not exact science, there is no reason why he should not regard the views he has borrowed from Empedocles as satisfactory provisional hypotheses which do fuller justice to the facts, so far as already ascertained, than any others. (3) Note also carefully that Plato assumes that the classification covers *all* the bodies in nature. As we shall see, the stars are 'fire and earth', fire being predominant in

them. There is no trace of the peculiar doctrine of Aristotle, according to which the 'roots' constitute only the bodies lying between the centre of the universe and the orbit of the moon, the celestial 'spheres' and the stars and planets in them being made of a nobler 'fifth body' (πεμπτὸν σῶμα), which is homogeneous and simple, and has a peculiar dynamics of its own. This theory of an absolute distinction between 'terrestrial' or 'sublunary' or 'elementary' matter, the matter, as we should put it, of which chemical compounds are formed, and 'celestial' matter makes astro-chemistry impossible in principle, and, since it was part of the Aristotelian theory that the dynamics of the two kinds of matter are radically different, the doctrine proved an even more serious impediment to the prevalence of sound views in astronomy at the revival of science in the early seventeenth century than the 'geocentric' hypothesis. It is to meet *this* false theory that Galileo dwells at such length on sun-spots, the unevenness of the surface of the moon, the existence of variable stars, in his famous *Dialogue on the Two World-Systems*. It is most important to be clear on the point that the whole theory of two radically different kinds of 'matter', each with its own peculiar dynamics, was not characteristic of Greek science in general; it was a most unfortunate invention of Aristotle in particular. Before him (as may easily be seen from any good work on early Greek science) no cosmologist had ever suggested that the 'heavenly bodies' are made of anything but the stuff of which all other bodies are made, or that the same dynamics is not applicable alike to the movements of planets and the movement of sticks and straws in an eddy or of a stone swung round by a string. This is as much the assumption of Anaxagoras and Empedocles and Leucippus as it is that of Newton. Aristotle invented the whole unhappy theory because he wanted to maintain the *divinity* of the heavenly *bodies*, and therefore to assert that they are unchanging and move always with absolute uniformity.[1] If they were made of the four 'roots', he thought, they could not be unchanging, for we habitually see one 'root' being transmuted into another (a point on which Aristotle agrees with the earlier Ionians and with Timaeus, and dissents from Empedocles), and if their dynamics were the same as those of terrestrial bodies, their movements ought to be rectilinear. But Aristotle held that since there is no infinite space, rectilinear movement cannot go on for ever in the same sense. If the 'heaven of the fixed stars' has a rectilinear path it must periodically reverse the sense of its movement, and thus there would be periodically recurrent breaches of continuity in a movement which, belonging to a divine body, ought to be everlastingly self-same, continuous, and uniform. Hence the dynamics of 'celestial matter' must be wholly different from the dynamics of earth, water, &c. The latter tend, if not interfered with, to move in rectilinear paths; the first 'law of motion' for celestial bodies is that when not interfered with (and they never are interfered with) they revolve in circles (see the long

[1] This was, in fact, a return to the notions underlying the myths of so many peoples, about Father Sky and Mother Earth and the tragedy of their separation. The most obvious of the many fatal objections to all attempts to derive the early Greek scientific cosmologies from ideas of this kind is that Greek science begins (with Anaximander) by rejecting all such conceptions. It starts with 'innumerable' *οὐρανοί*, not with one.

exposition of all this in *Physics* Θ. 258^{b} 10–265^{a} 12). On this theory the 'circular revolutions' of heavenly bodies needs no explanation, being simply 'natural', an '*ultimate* inexplicability'; in fact, that gravitation in which Newton found the key to the mechanics of the solar system, requires no further explanation whatever. We must not ask at all for a 'cause of gravitation'. As we shall see, this is one of the main points of difference between Plato and Aristotle (as it is also a main point of difference between Aristotle and Newton), and was recognized as such by Platonists in antiquity. (4) We note again that at 31 b 4 it is expressly taken for granted that the nature, or physical world, studied in the natural sciences is just the very world we apprehend by sight, touch, and the other senses. This does not mean that sense-perception, unanalysed and uncriticized, gives us full and accurate knowledge of nature. But the bodies of which the physicist talks are just the *very same* bodies we see and touch, though the physicist knows a great deal more about them than the rest of us do.

This view is sharply opposed to that which was very common in the nineteenth century, and is often expressed even to-day by men of science (especially biologists) who have had no thorough training in general philosophy. According to that view the world perceived through the senses is only an 'effect' produced 'in us' (sometimes it is said to be produced 'in our minds', sometimes 'in our brains'), by the action of the 'real' physical world. The things the physicist talks about, 'atoms', 'ether', 'energy', are then supposed to be no part of the 'effect' we perceive, the *sensible* world, but to be the 'real' imperceptible *causes* of the perceived effects. It is accordingly supposed that in studying physics we are getting 'behind the veil' of sensation to the 'realities'. The origin of this view is historically to be found in the doctrine held on rather different grounds in each case, by Galileo, Descartes, and Locke that the so-called 'secondary' or 'sensible' qualities of bodies are really 'subjective' or 'mental'; they are effects produced 'in us' by the action of the 'primary qualities' (the *geometrical* characters of particles *plus* impenetrability), which are assumed to be 'really' there in bodies outside us. As Locke puts it, the secondary qualities, unlike the primary, have no 'archetype external to the mind'; what corresponds in the 'external body' to such a quality is only a 'power' to produce a certain effect 'on us'. The modern man of science who believes that in theorizing about 'ether' or 'energy' he is getting behind the 'veil' of appearances at 'real' things often extends the supposed 'subjectivity' even to what Locke calls the 'primary' qualities (those which are taken into account in mechanics), and supposes them also to be 'effects' produced in us by certain absolutely imperceptible realities, 'ether', 'energy', or the like, of which he maintains that we know only that they are unchanging, and that they are the causes of these effects 'in us'. (This is, for example, the point of view which is maintained, not without a good many inconsistencies, in Professor Karl Pearson's well-known *Grammar of Science*.) All that I wish to say for the purposes of this commentary on the conception may be summed up under two heads.

(1) The arguments for the 'subjectivity' of sensible qualities only

appear plausible through a bad confusion. (*a*) It is argued that to perceive e. g. the various shades of red you need a properly constituted eye, as we discover from the fact that a man with a 'colour-blind' retina cannot see red at all. Now this does not in the least prove that the red colour of a scarlet geranium does not 'really' belong to the geranium; it only proves that one eye can take in what the geranium is more completely than another. It ought to be obvious that when I see a red geranium that which I 'see to be red' is not my mind (nor yet my brain, nor yet my retina), but the flower. My mind, my brain, my retina are just what I do not see. Even if there were good reasons for thinking that I am mistaken when I say 'that flower is red', there are no reasons at all for the assertion that what is red is my mind (or my brain or my retina). What is really 'subjective' in the perception is not the red colour of the geranium but the act of seeing it as red. The man who talks of colour as 'subjective' has never learned to make this simple and necessary distinction. *Seeing* red is a 'subjective' act, just as believing that granite is hard or that Wellington commanded at Waterloo; the red I see need no more be 'subjective' than Arthur Wellesley first Duke of Wellington or the granite of which Aberdeen is built.[1] (*b*) Also there is nothing in the laws of physical science themselves which requires us to interpret them as though the 'atoms' or 'ether' or 'energy' of the physicist were imperceptible causes of appearances. The laws themselves can equally well be interpreted as statements about relations between sensible facts. To understand what is meant by the Conservation of Energy I do not need to suppose that 'energy' is an imperceptible something which *causes* the appearances I call 'light', 'heat', and so forth. The law only states that when a definite quantum of one of these perceptibles disappears a definite quantum of some other reappears. There need be nothing *but* the sensible 'manifestations', 'radiant energy', 'energy of chemical action', and the rest, just as one can use 'guineas' as units by which to reckon sums of money though no guineas are actually coined. To suppose that the 'manifestations' are 'appearances' of some one thing which is the 'reality behind' them is a piece of superfluous and questionable metaphysics. Thus so far as the actual statements of the sciences go, they are most naturally interpreted as statements about relations between 'sense-data'. Only we must remember that sense-data, 'perceptibles' include not only the things which actual men actually perceive but everything which is of the same *kind* as the actually perceived, though it may happen to be actually perceived by no man, either because there is no man there to perceive it or because it is

[1] There is, however, a further very difficult problem. In sense-perception have we simply a relation between the percipient and the 'physical' object perceived (as is held e.g. by Professor Alexander), or is there a third term involved, the 'presentation' or 'sensum'? For a full discussion and an elaborate working-out of the second view see Broad, *Scientific Thought*, ch. 7, 8. For the purposes of the present commentary, it is sufficient to remark that on neither view is the colour I see 'subjective', in the sense of being a 'state' of my mind or my brain. Even on the second view, the 'sensum', though not the 'physical' object, is still the 'seen' object. It would not be what it is in the absence of the percipient, but it is not a 'state' of the percipient.

'below the threshold' of *our* senses. Imperceptibles of this kind are assumed in all physics, but there is no need to assume imperceptibles in the sense of things which from their very nature are different in kind from what is perceived. The argument leads to the conclusion that the physical nature studied in the sciences is actually *made* of sense-data, colours, sounds, odours, temperatures, and the like. The only significant difference between the so-called 'primary' and 'secondary' qualities will be that the primaries are relatively more permanent, whereas the secondaries, though equally 'objective', are more variable. Thus the colour of a bit of stone varies with the illumination, but its mass is so nearly unvarying that it is only in the latest developments of electromagnetic theory that the view that mass is not absolutely constant has emerged.

(2) In *mechanics* we need only consider the 'primaries'. This is because bodies, so far as we know, only act on one another in virtue of their primary qualities, though they act on living organisms in virtue of their secondary qualities. The colour of a stone which falls makes no difference, as its mass does, to its effect in crushing or breaking the body on which it falls, but the colour of a flower may make all the difference to an insect's behaviour towards it. This is, however, no reason for regarding the 'secondary' qualities as in any way 'subjective' or 'unreal'.

Plato's view of the physical world is thus one which regards the nature studied by the physicist and chemist and the sensible world taken in through our eyes, ears, and the other organs of sense as identical. Since to say that the physical and sensible 'worlds' are the same is equivalent to saying that we perceive 'real bodies' and their behaviour, not 'effects' produced 'in us', we may call this view, if we like, *realistic* as opposed to the *phenomenalistic* view that physics is concerned with imperceptibles which are 'behind the veil'. It is the view Berkeley is really intending to prove by his arguments for the non-existence of 'matter'. He meant to deny that the 'realities' are imperceptibles 'behind the veil', of which the perceptible is a mere 'phenomenal effect'. His object was to attack the theory that what really exists in nature is minute corpuscles, with none but 'primary' qualities, and that all the apparent sensible wealth of the world is an illusion. All his most telling arguments in the *Principles of Human Knowledge* and the *Three Dialogues* are addressed to the proof that the 'real' thing is the thing we perceive. Thus Berkeley meant, as far as his theory of nature goes, to be what is now called a '*naïf* realist', but unfortunately he went on to suppose that because it takes a mind to perceive colours, sound, &c., they must be 'in' the mind, i.e. they can only exist while they are *actually* being perceived, and further, the very *meaning* of the proposition that they exist is that they are being perceived (their esse *is* percipi).[1] It is this which led to the mistake

[1] 'The *esse* of bodies is *percipi*.' This does not merely mean that a body only exists when it is being perceived. If this were all, it might be urged that the statement may be true, and is certainly impossible to refute, since we do not *know* that every body may not be at every moment of its existence perceived by some mind. Berkeley meant not only that all existing bodies are perceived bodies, but that the proposition

of supposing that his intention was to make out physical things to be '*states* of our minds', a doctrine which he does not teach, and could not teach without contradicting his own fundamental distinction between the mode of being of 'spirits' and the mode of being of 'ideas' (= the *objects* of sense-perception). So far as the denial of the existence of 'matter' goes, Berkeley is rightly protesting against all forms of the 'bifurcation of nature', and Timaeus is on his side when, as we shall see, he constructs an elaborate doctrine of physics in which there is no room for the imperceptible, 'matter'. The contemporaries who thought Berkeley could be refuted by kicking a stone were making the crude confusion of the denial of the existence of 'matter' with a denial of the reality of sensible bodies.

31 b 4. καὶ ὁρατὸν ἁπτόν τε. The *καί* and *τε* are not correlatives (see Kühner-Gerth iv, p. 251 n. 2); the use of *τε* for *καί* to connect 'single notions', as here, is against prose rule (op. cit. p. 241), and seems to be deliberately meant to give T.'s language a poetical colouring. Since *καὶ . . . τε* usually = *praeterea . . . et*, I should like, for the sense, to take *σωματοειδές* with *τὸ γενόμενον*, 'that which has come into being as bodily must further, of course (*δή*), be visible-and-tangible', though the hyperbaton is a harsh one. The violent hyperbaton is for the sake of getting the proper emphasis on *σωματοειδές*. Cf. 40 d 2 *ἄνευ δι' ὄψεως τούτων αὖ τῶν μιμημάτων* and *n.* ad loc.

Of the sensible qualities of bodies those apprehended by sight and touch are appropriately selected for special mention because (1) it is by these senses that we take in the *shapes* and *sizes* of bodies, and (2) because perceived bodies are not always giving out tones or odours and are not all possessed of tastes, but every body that is perceived at all is perceived with a size and a shape. Hence sight and touch are *par excellence* the senses which apprehend body, though all the senses are concerned with qualities or relations of bodies, and body is in Plato a name for 'that which is perceived by the senses'.

But there is a further historical explanation of the way in which Timaeus starts with sight and touch, at least if we accept the view, which Bt. seems to me to have put beyond reasonable doubt (*EGPh.*[3] 182–7), that the dualistic cosmology given in the second part of the poem of Parmenides as the 'opinions of mortals in which there is no truth' (*τοῖς οὐκ ἔνι πίστις ἀληθής*), is Pythagorean. The persons whose opinions are being described assume two 'forms' (*μορφαί*), one of which they ought not to admit, i.e. they construct the world out of two opposed and

'this body exists' *means* precisely the same thing as the proposition 'this body is being perceived'. Before we can be expected to admit *this* we ought to be provided with some proof, e.g. that Neptune, which could be shown to be there before it had been seen, must actually have been *seen* by some one before our telescopes revealed it. There is no easy way of proving this. Berkeley himself falls back on the omniscience of God, but his argument really requires that God shall not merely know all true propositions, but shall actually and literally 'see' all colours, 'hear' all sounds, and so forth. A reasonable Theist would certainly demur to this license of affirmation about the mode of God's knowledge. Also, if esse *is* percipi, it must be true that percipi *is* esse, and we need at least to be satisfied that this proposition is compatible with the occurrence of genuine hallucinations.

antithetical factors. Parmenides speaks of the two 'forms' (Fr. 6. 53–9, *Fr. d. Vors.*[3] 1. 158, R. P. 121) as Fire and Night, and Simplicius (in *Physica* 25, 15, quoted at *EGPh.*[2] 186 n. 2) and Plutarch (*Adv. Colot.* 1114 b) bear out the statement, Simplicius saying that the two *μορφαί* are light and darkness, Plutarch that they are 'the bright and the dark' (*τὸ λαμπρὸν καὶ τὸ σκοτεινόν*), so that it seems clear, as Bt. also holds, that Aristotle was inaccurate in stating (*Physics* A. 188[a] 21) that they are 'fire and earth'. But there is a probable explanation of Aristotle's inaccuracy which considerably reduces its magnitude. There is abundant evidence that Pythagorean cosmology started from the old Milesian view of the world. Now in the final elaboration of this view by Anaximenes, the 'boundless' out of which all the worlds arise was identified with *ἀήρ* in the old Homeric sense of cloud or mist (a sense in which we shall find Timaeus himself made to use it by Plato). As night, before the time of Empedocles, was regularly thought of as a sort of thick cloud rising from the sea or the valleys, we can quite understand that the 'Night' of Parmenides' poem is just the *ἀήρ* which had been the primary substance in the cosmology of Anaximenes. It was the theory of Anaximenes that 'earth' is simply highly condensed *ἀήρ*. Hence we can understand why Aristotle finds it natural to call the two *μορφαί* mentioned by Parmenides, fire and earth, and, if the whole theory is, as it seems to be, that of Pythagoreans of the end of the sixth century,[1] we can see that Timaeus is proceeding on strictly Pythagorean lines in mentioning as the fundamental necessity for cosmology the opposition between *fire* and 'earth', which will be just the extreme form of what Parmenides calls 'night', when carried to the limit of condensation. Having thus started, as in duty bound, with a duality of 'roots' Timaeus has to go on to show that he can incorporate Empedocleanism in his scheme by finding a place for the other two, air and water. But note that, after all, these two may be said in a way to be secondary; God '*began*' with a pair of opposites (*ἐκ πυρὸς καὶ γῆς τὸ τοῦ παντὸς ἀρχόμενος συνιστάναι σῶμα ὁ θεὸς ἐποίει*).[2] Theophrastus, as Proclus tells us (Diehl ii. 6), fell foul of Plato for ascribing a peculiar property to fire, that it is visible, and to earth, that it is tangible, but not providing *propria* for the other two 'roots'. *τί δή ποτε πυρὸς μὲν ἴδιον εἶπε τὸ ὁρατὸν καὶ γῆς τὸ ἁπτόν, τῶν δὲ λοιπῶν στοιχείων οὐδέν;* This is a good example of the way in which Aristotle and Theophrastus 'pick holes' in Plato. As Proclus observes, Timaeus does not say what Theophrastus makes him say. He does not say e. g. that nothing but fire is visible, but only that without fire nothing would be visible.

31 b 6. *στερεοῦ*, 'solid', not in the purely geometrical sense, but in the physical sense of offering resistance to pressure or deformation, 'hard'

[1] The goddess of the proem to Parmenides' poem addresses him as a 'youth' (*ὦ κοῦρ'*, v. 24, R. P. 113). Hence his poem was presumably written, and his conversion from Pythagoreanism effected, fairly early in life. According to Plato, when Parmenides met the young Socrates, the former was about sixty-five. Thus he must have been born about 515 B.C., and the Pythagoreanism he describes is of the beginning of the fifth century. As he assumes that the doctrine he is opposing is an established one holding the field, it may be in the main that of Pythagoras himself.

[2] Is it possible that it may have been a reminiscence of this very passage which led Aristotle into the loose statement that the two *μορφαί* in Parmenides are *πῦρ* and *γῆ*?

(like Newton's 'corpuscles'), 'solid' in the sense in which we contrast 'solids' with 'fluids', which yield readily to pressure in any direction.

31 c 1–2 δεσμὸν γὰρ . . . γίγνεσθαι. The characters of earth and flame are so different that if they are to combine there must be some other ingredient or ingredients intermediate in character between them, which serve as the glue or cement to weld them together. Timaeus thus provides a *raison d'être* for the remaining two 'roots' and goes on to work the whole doctrine into his Pythagorean framework by giving a mathematical turn to it. The best 'bond of union', that which makes itself and the terms it links most completely one, is an ἀναλογία or *progression* in which the first and last terms have a 'mean' or intermediate term or terms connecting them by a mathematical law. The study of ἀναλογίαι was originated by Pythagoras and his followers, and the name was first used of the three simple forms of series which we still call 'progressions', the *Arithmetical*, in which the difference between each term and the immediately preceding is constant (e.g. 1, 2, 3, 4, 5... where the constant difference is 1; 1, 3, 5, 7... where it is 2); the geometrical, where each term has a constant ratio to the preceding (e.g. 1, 2, 4, 8, 16... where the constant ratio is 2/1; or 1, 3, 9, 27... where it is 3/1); and the harmonic, for which the rule is that the difference between the third term and the second bears to the third term the same ratio which the difference between the second and the first bears to the first (e.g. 6, 8, 12... where $\frac{12-8}{12}=\frac{8-6}{6}$, both ratios being 1/3). All three were early discovered by the Pythagoreans (presumably, as the persistent tradition asserts, by Pythagoras himself), from their musical studies. If we take three vibrating strings of which the second gives a note an octave below that of the first, and the third a note an octave below that of the second, the length of the strings are found to be in the proportions of x, $2x$, $4x$, and 1, 2, 4 is a geometrical progression. (Obviously the general expression for a geometrical mean between two numbers, a and c, will be $\sqrt{ac}$, since $\frac{\sqrt{ac}}{a}=\frac{\sqrt{c}}{\sqrt{a}}=\frac{c}{\sqrt{ac}}$.) If we take three strings sounding a given note, its major fourth and its upper octave, the lengths of the strings are proportional to 12, 8, 6, a descending harmonic progression. (The formula for the harmonic mean between a and c is clearly $\frac{2ac}{a+c}$.) If we take strings which sound a note, its major fifth and its upper octave, the ratios for the lengths of the strings are 12, 9, 6, and this is an arithmetical progression, since $12-9=3=9-6$. (The arithmetic mean between a and c is, of course, $\frac{a+c}{2}$, since $c-\frac{(a+c)}{2}=\frac{c-a}{2}=\frac{a+c}{2}-a$.) Thus the harmonic and arithmetical means are discovered at once for these special cases when you discover the ratios corresponding to the two fundamental intervals of the octave (the fourth and the fifth); the geometrical mean, for the special case where the constant ratio is 2/1, is found as soon as you know the ratios corresponding to ground-tone, octave, second octave. (Cf. Plat. *Epinomis* 991 a–b.)

The word *ἀναλογία* was subsequently extended to *all* proportion, i. e. equality of ratio. In this more extended sense 6, 7, 12, 14 is an *ἀναλογία*, because the ratio 6/7 is equal to the ratio 12/14. The terms of such a proportion are then said *ἀνὰ λόγον εἶναι*. (Cf. Euclid, *Elements* v, *def.* 6 *τὰ δὲ τὸν αὐτὸν ἔχοντα λόγον μεγέθη ἀνάλογον καλείσθω*, and *def.* 9 *ὅταν δὲ τρία μεγέθη ἀνάλογον ᾖ* κτλ.) It is in this sense that the word is being used at 31 c 3. For a good account of the various *ἀναλογίαι* cf. Theon Smyrnaeus (ed. Hiller) pp. 82–6.

31 c 4—32 a 7. ὁπόταν γὰρ ἀριθμῶν . . . πάντα ἔσται. Timaeus gives a reason why there should be two and not only one intermediary between earth and fire, i. e. why he works with four kinds of body and not with three. In an *ἀναλογία*, or proportion,[1] the mean, or middle, term must stand to the last in the same ratio in which the first term stands to the middle term. This sameness of ratio is the 'bond' (*σύνδεσμος*) which makes the whole system of the terms into a true unity. (When we remember that *order* is characteristic of the good, we see that this is a mathematical way of putting what Socrates had said in the *Phaedo*, that it is 'the good' which holds all things together. The reason why there are mathematical laws in nature is that goodness and reason, not evil and unreason, prevail in the universe. We may also compare the remark of Socrates to Callicles—*Gorgias* 508 a 6—that *ἡ ἰσότης ἡ γεωμετρικὴ καὶ ἐν θεοῖς καὶ ἐν ἀνθρώποις μέγα δύναται*, geometrical equality, that is equality of ratio, is most potent in heaven and on earth. Why it is so potent 'in heaven' we shall see from the *Timaeus* as we go on; it is potent on earth because, as the law by which men's lot is proportioned to their desert, it is the rule of 'even-handed justice'.) Now, between two 'planes' you can always insert a single 'mean' or middle term, such that, if a, c be the two 'planes', $a : b :: b : c$. But, as our sensible world is to be made of *solids*, which have *three* dimensions, this cannot be done; you need to insert between your extremes, a and d, *two* 'means', b, c, to ensure that you shall have the *ἀναλογία* $a/b = c/d$. And to make the unity of the system complete and perfect, the ratio b/c must also be equal to each of the ratios a/b, c/d.

To explain this we have to bear in mind two things: (*a*) Plato means to have a *continued proportion* (*ἀναλογία συνεχής*). He demands perfect symmetry. Not merely are we to have $a/b = c/d$, but also $b/c = a/b = c/d$. This means that the four terms of such an *ἀναλογία* must form a *geometrical* progression, the ratio of each term to its immediate precursor being constant. (As the series is to correspond to the four 'roots' of which bodies are made, we already begin to see something of the cosmical significance of 'geometrical equality' hinted at in the *Gorgias*. (*b*) Timaeus is speaking in the language of the Pythagoreans, who thought of numbers as spatial. Thus they looked on the unit 1 as a 'point' or dot, on an integer in general as a length (a straight line, or 'row' of units); a number which can be resolved into two factors was thought of as a rectangle, e. g. 6 as a rectangular area with 3 and 2 as its length and breadth; a number

[1] T. tacitly puts on the word *ἀναλογία*—originally a name for all the 'progressions' just described—the more special sense of *proportion*, equality of *ratio*.

with three factors was regarded as a solid (e.g. $24 = 4 \times 3 \times 2$ was regarded as a parallelepiped with length 4, breadth 3, and depth 2). This language has persisted in the arithmetical parts of Euclid's *Elements* and the other extant Greek treatises on arithmetic. Cf. Euclid vii. *Def.* 17 ὅταν δύο ἀριθμοὶ πολλαπλασιάσαντες ἀλλήλους ποιῶσί τινα, ὁ γενόμενος ἐπίπεδος καλεῖται, πλευραὶ δὲ αὐτοῦ οἱ πολλαπλασιάσαντες ἀλλήλους ἀριθμοί, 'when two numbers multiplied together produce a third, the number so produced is called *plane*, and the numbers which are multiplied together its *sides*'; ib. 18 ὅταν τρεῖς ἀριθμοὶ πολλαπλασιάσαντες ἀλλήλους ποιῶσί τινα, ὁ γενόμενος στερεός ἐστιν, πλευραὶ δὲ αὐτοῦ οἱ πολλαπλασιάσαντες ἀλλήλους ἀριθμοί, 'when three numbers multiplied together produce a fourth, the number so produced is a *solid* number, and the numbers multiplied together its *edges*'. So we still speak of 'square' and 'cube' numbers. (On the whole subject of the Pythagorean arithmetic see *EGPh.*[3] pp. 99–108, *Greek Philosophy: Thales to Plato* pp. 51–6.) Timaeus may certainly be taken to mean by an ἀριθμός a 'natural integer' (πλῆθος μονάδων, a 'collection of ones' is the definition still preserved by Euclid (*Elements* vii. *Def.* 2)), and that the 'means' of his progression are *rational* integers; he does not allow for *surds*. (In spite of Plato's own view, expressed at *Epinomis* 990 d, that 'quadratic' and 'cubic' surds are ἀριθμοί, it always remained the 'official' theory of ancient mathematics that there are irrational 'magnitudes' (μεγέθη), but no irrational *numbers*.) What he means, then, is that between what he calls 'plane' numbers, you can always insert a single rational geometrical mean. Thus if a and b are any integers you can always insert between a^2 and b^2 the rational geometrical mean ab. (As the definitions quoted above from Euclid show, though *any* number which is the product of two factors can be called 'plane', the name belongs in a more exclusive sense to numbers which are the product of two *prime* factors, and so can be represented as *only* products of two factors and not of more. Similarly, the name 'solid' numbers belongs in a more special sense to those which are products of three *prime* factors. It is only if you assume the factors of the product to be prime that the factorization is *unique*. Timaeus is thinking of this resolution into *prime* factors.) His point about 'plane numbers' may be readily illustrated thus. Between $2^2 (= 4)$ and $5^2 (= 25)$ we can obviously insert the integral mean $5 \times 2 (= 10)$ so that $4/10 = 10/25$. But between two 'solid' numbers, e.g. between a^3 and b^3, you cannot universally insert a single rational integral mean; the geometrical mean between a^3 and b^3, which is $\sqrt{a^3 b^3}$, will, as a rule, be a surd. For, example the 'mean' between $2^3 (= 8)$ and $3^3 (= 27)$ will be $\sqrt{8 \times 27}$ $(= 6\sqrt{6})$, and this is a surd. You can, however, in this case always make a geometrical progression of which the terms are rational integers by inserting *two* geometrical means, so as to get a 'continuous proportion' with four terms. For $a^3 : a^2 b :: ab^2 : b^3$ forms such a progression; the constant ratio being b/a. Thus between 8 and 27 you can insert the two 'means' $2^2 \times 3 (= 12)$, $3^2 \times 2 (= 18)$ and 8, 12, 18, 27 form a 'continuous' ἀναλογία in which the ratio of every term after the first to the preceding term is 3/2. This is plainly what Timaeus means to say, though there is an apparent diffi-

culty about the language. As the commentators point out, you can *sometimes* insert a single geometrical mean between two 'cubes'. For example, $4^3 = 64$ and $9^3 = 729$, and between 64 and 729 we can insert the single geometrical mean 216, so that $216/64 = 729/216$.[1] But this is only possible because 64 and 729 are themselves 'squares' as well as 'cubes'; $64 = 8^2$ and $729 = 27^2$. Again, you can insert the one 'mean' 64 between the solids 8 and 516, but here $64 = 8^2$ and $512 = 8^3$, so that the series is 2^3, 2^6, 2^9, and once more the three factors of 2^9, $8 \times 8 \times 8$ are not *prime*. The difficulty is removed if we suppose that by 'plane' and 'solid' numbers Timaeus means not merely numbers which *can* be represented as products of two and of three factors respectively, but numbers which can *only* be represented in this way, i.e. numbers which are products respectively of two and of three *prime* factors. Since ἀριθμός in Greek arithmetic regularly means 'integer', it follows also that the 'extremes' of the progressions must be numbers which are perfect squares or cubes. For otherwise the proposition that between two 'planes' you can always insert an ἀριθμός, and between two 'solids' you can always insert *two* ἀριθμοί as means will not be true.[2] This is the view of the passage taken by Martin, and it appears to me sound.

Of course this reasoning is not given by Plato as a *demonstration* that there must be neither more nor less than four 'roots'. It is simply a play of mathematical fancy, such as would naturally occur to a Pythagorean interested in bringing his arithmetic into connexion with the medicine of the Sicilian school originated by Empedocles. If we knew more about Philolaus and his contemporaries we might very possibly find that Plato is reproducing something which they actually said. It is clearly an indication of this same tendency to combine Pythagoras with Empedocles that the 'four' roots of Empedocles are mentioned in the list of

[1] Also, as Proclus points out, you *can* in some cases insert more than one mean between two 'planes'. E.g. 16, 24, 36, 54, 81 form a geometrical progression with the constant ratio 3/2. And the extremes 16, 81 are 'planes' (4×4 and 9×9). Hence it is clear that Plato means to say not that you can never insert more than one mean between two 'planes', but that you can *always* insert one, which satisfies the condition that the result shall be a geometrical progression (e.g. 16, 36, 81). Here again, of course, the possibility of inserting *more* than one 'mean' and still having such a progression is due to the fact that 4 and 9 are not *prime* numbers.

[2] There is extant evidence that the name 'linear' numbers was originally given to those which cannot be represented by a pattern in two or three dimensions. Cf. Iamblichus *in Nicomach. Introd.* 57. 3 (Pistelli) ἰδίως δὲ εὐθυγραμμικοὶ καλοῦνται οἱ διάγραμμα ἐπίπεδον μὴ ποιοῦντες, ὡς ὁ ε̄ καὶ ὁ ζ̄ καὶ οἱ ὅμοιοι. These would, of course, all be primes. The mention of ε̄ as εὐθυγραμμικός suggests that the early Pythagoreans had only studied the most elementary patterns, and that the further developments given, e.g. by Theo of Smyrna, which recognize 'pentagons' and 'hexagons' and even give the formula for *n*-agons, where *n* is any finite number, are a later generalization. Martin thus seems right in supposing that Timaeus is assuming the numbers of which he is speaking to possess two and only two, or three and only three, *prime* factors, as the case may be, from which it follows that his ἐπίπεδοι are squares and his στερεοί cubes of prime numbers. Boeckh (*de Platonica corporis mundani fabrica*, *Kl. Schr.* iii. 238) attempts a more far-fetched geometrical explanation, but does not seem quite satisfied with it himself. Yet in an appendix, written in 1865, with Martin's work before him, he insists on his own solution more vigorously than ever (*Kl. Schr.* iii. 253 ff.). Here, as in other similar cases, he seems to me ill advised by his mathematical friends.

tetractyes or groups of four given by Theo Smyrnaeus (ed. Hiller, p. 97), where the quaternion of the 'uncompounded bodies', is the fourth of the eleven specified. Theon gives a turn to it which is not to be found in Timaeus, and is not consistent with his physical theory. He regards the *densities* of the 'elements' in the order given as standing in the ratios 1 : 2 : 3 : 4, and so as represented by the terms of the original Pythagorean τετρακτύς, 1, 2, 3, 4).

31 C 4. **ἀριθμῶν τριῶν εἴτε ὄγκων εἴτε δυνάμεων,** 'three integers or *ὄγκοι* or *δυνάμεις*.' The **εἴτε** is suppressed before the *first* of the alternatives. For parallels cf. *Sophistes* 217 e 1 *ἀπομηκύνειν λόγον συχνὸν κατ' ἐμαυτὸν, εἴτε καὶ πρὸς ἕτερον*, ib. 224 e 2 *καπηλικὸν εἴτε αὐτοπωλικόν*. The effect of the suppression is to throw special stress on the *first* alternative as that which is chiefly contemplated, 'three integers, or—for the matter of that, three *ὄγκοι* or *δυνάμεις*', 'to deliver a long discourse to myself, or, it may be, to a companion', 'retailing the wares of others, or possibly selling his own manufactures'. But what are *ὄγκοι* and *δυνάμεις*? The explanation of Proclus is pretty clearly right. He takes *ὄγκοι* to mean, as it usually does, 'bulks', 'volumes'. (So Heraclides Ponticus is said to have called the 'molecules' of his corpuscular theory *ἄναρμοι ὄγκοι* 'uncompounded volumes'. As Heraclides is known to have given some account of the theories of the Pythagorean Ecphantus, it is not impossible that the phrase may actually belong to Ecphantus and so be Pythagorean. Cf. also Plat. *Parm.* 164 d 5 *τοιούτων δὴ ὄγκων ἄλλα ἀλλήλων ἂν εἴη τἆλλα, εἰ ἑνὸς μὴ ὄντος ἄλλα ἐστίν.—κομιδῇ μὲν οὖν.—οὐκοῦν πολλοὶ ὄγκοι ἔσονται κτλ.*, where the speaker is Parmenides himself.) What the *δυνάμεις* mean Proclus explains by saying that the 'high' (*ὀξύ*), and 'low' (*βαρύ*), in musical pitch are an instance of such a *δύναμις*, and that the interval of the fourth is a 'mean' (*μέσον*) between the 'high' and 'low' extremes of the octave. Thus Timaeus will be illustrating his general proposition about 'means' by an example taken from each of three Pythagorean studies, arithmetic (*ἀριθμῶν*), geometry (*ὄγκων*), music (*δυνάμεων*).

32 a 3. **τὸ μέσον μὲν πρῶτον καὶ ἔσχατον γιγνόμενον.** If you have a geometrical progression $a : b :: b : c$, it is also true *convertendo* (*ἀνάπαλιν*) that $b : a :: c : b$. Thus you can make the 'middle term' first and last, and the 'extremes' middle terms still preserving the equality of ratio.

32 C 2. **φιλίαν τε ἴσχειν ἐκ τούτων.** This may be an allusion to the names *φιλότης*, *φιλία*, *Ἀφροδίτη*, given by Empedocles to that 'attraction' of unlike 'roots' for one another which accounts for the formation of compounds. So we still talk of 'chemical affinity'. Empedocles had *postulated* this attraction and its counterpart *νεῖκος* 'repulsion', both thought of naïvely as bodies, along with the four 'roots' to account for the existence of an organized world. Timaeus can do without 'love' or 'strife' as an ultimate postulate, since he accounts for *φιλία* by the mathematical skill with which God has made the four 'roots' terms of a continuous progression. How he accounts for 'repulsion' and the dissolution of compounds we shall see later on.

32 C 2—33 A 6. **ὥστε εἰς ταὐτὸν . . . φθίνειν ποιεῖ.** Timaeus will not say that the world is absolutely indestructible; this would amount to denying its dependence on God. But it is to be indissoluble except by the purpose

of God (ἄλυτον πλὴν ὑπὸ τοῦ συνδήσαντος), and, God, being good will not purpose to undo what has been *well* put together (41 b 1). That the οὐρανός is καλῶς ἁρμοσθέν and εὖ ἔχει Timaeus tells us over and over again. It follows that *his* cosmology contemplates no alternate distinctions and reconstructions of the οὐρανός, like those which occur in Empedocles at the points of the cycle where φιλία or νεῖκος is wholly predominant. (We may fairly suppose that his language is actually pointed at the lines of Empedocles—Fr. 139, R. P. 167—about the 'oath' in virtue of which, at the appointed time, 'strife' demands its 'prerogatives'; according to T. the φιλία introduced by God into the very plan of the οὐρανός is *never* expelled.) *De facto*, though not strictly *de iure* (for τὸ δεθὲν πᾶν λυτόν, 41 a 8), the world is everlasting. It follows that the whole of the 'roots' are used up in its construction; there is no reservoir of unused stuff outside the οὐρανός. For it is inferred by analogy from the μικρὸς κόσμος of the human body that just as unfavourable conditions in the 'environment' break up the human frame and cause age and disease, the frame of the world might 'disjoint' if the οὐρανός had an 'environment' which could get 'out of tune' with it. This consideration cuts out not only the alternate 'cycles', but also the old Ionian conception of a 'boundless' which 'encompasses' the 'worlds'. Here, as on the point about the uniqueness of the οὐρανός, Timaeus represents a 'development' within Pythagoreanism which repudiates prominent features of the original doctrine.

33 a 2. ἀγήρων καὶ ἄνοσον. The poetical expression—it is an echo of Sarpedon's ἀγήρω τ' ἀθανάτω τε in his speech to Glaucon (*Iliad* M. 323)—is meant to recall the language of the old Ionian physicists. Anaximander is quoted by Aristotle (*Physics* 203^{b} 13, R. P. 17) as calling his 'boundless' ἀθάνατον καὶ ἀνώλεθρον, where ἀνώλεθρον is perhaps Aristotle's own substitute for the poetic ἀγήρων of Homer. So in the famous fragment of Euripides about the scientific life (Nauck Fr. 902) the man of science is said to contemplate the order (κόσμος) of 'ageless, immortal φύσις', ἀθανάτου . . . φύσεως | κόσμον ἀγήρω. In Anaximander it is the 'boundless', not the perishable οὐρανοί on which the Homeric epithets are bestowed, and this is also what Euripides means (*EGPh.*^{2} 10 n. 3). Timaeus, who has no 'boundless' body in his scheme and only one οὐρανός, which is *not* perishable, significantly transfers the description to the οὐρανός itself. For the ἄνοσον cf. the long Fr. of the Eleatic Melissus of Samos numbered 7 in *Fr. d. Vors.*^{3} (R. P. 145) where it is said that 'what is', 'reality', cannot feel pain (οὐδὲ ἀλγεῖ), because 'if it felt pain it could not be All (πᾶν), for a thing that felt pain could not be always, nor have so much strength (δύναμις) as that which is in health (τὸ ὑγιές)'. Plato does not forget to make Timaeus use a vocabulary suited to his date and the affinities of his school. (When we remember that the Pythagoreans held that 'disease' is due to lack of proper proportion in the 'blending' (κρᾶσις) of the components of the body, we may suspect that it is their dualism which Melissus has in mind in making the point that the '*one* real being' of the Eleatics, unlike anything which is a compound of more than one factor, 'cannot feel pain'.)

33 a 3. συστάτῳ σώματι. This—the obviously correct reading—is not

conjectural, but was that of Proclus. (*τὸ δὲ σύστατον σῶμα τὸ σύνθετόν ἐστι*, Diehl ii. 64. 10, ib. 26 *πᾶν σῶμα σύστατον*). *ξυνιστᾷ τῷ* F, *ξυνιστὰς τῷ* A (an alteration, however, of something now erased), *ξυνιστᾶν τῷ* Y are plainly mere corruptions of *συστάτῳ*. The word is exceedingly rare, and only occurs elsewhere in late Greek. This accounts for its early corruption. Cicero translates 'omnis enim *coagmentatio corporis* vel calore vel frigore vel aliqua impulsione vehementi labefactatur', which apparently means that he read *συστάτῳ*; Chalcidius omits the word. Philo—if it is he—has in his citation of the sentence (*de incorruptibilitate Mundi* 11 = *de Mundo* 10) *τὰ τῷ*, a manifest trace of ⟨*συσ*⟩*τάτῳ*.

33 b 1—34 a 7. *σχῆμα δὲ ἔδωκεν . . . ἄπουν αὐτὸ ἐγέννησεν.* The shape of the heavens is that which is best, i. e. most appropriate to the creature which is to contain all other creatures within itself. It is therefore *spherical*, because the sphere contains 'all figures' (*σχήματα*) in itself. The *σχήματα* alluded to are the famous five, regularly called in later antiquity, when it had been proved by Theaetetus and his associates in the Academy that these five and no other 'regular solids' can be inscribed in the sphere, the 'figures of Plato' (*Πλάτωνος σχήματα*), the tetrahedron, cube, octahedron, dodecahedron, and icosahedron. The thirteenth book of Euclid's *Elements* gives the constructions for inscribing all five in the sphere and the proof that there are no other regular solids capable of inscription besides these. Timaeus argues that the figure—the sphere—which contains them all, and has the greatest volume of all 'regular figures' of equal surface is the appropriate shape for the *ζῷον* which is to contain all other *ζῷα*. There is a further appropriateness which T. does not here anticipate, due to the fact that these five figures have each its special part to play in the detailed system of his physics.

The ancient tradition was that the Pythagorean precursors of the Academy knew how to inscribe three of these figures, the tetrahedron, cube, dodecahedron, in the sphere, but that the inscription of the octahedron and icosahedron, as we have it in Euclid XIII, was the discovery of Theaetetus. (See the prefatory Scholium to *Elements* XIII in Heiberg's text of Euclid, vol. v, p. 654 *ἐν τούτῳ τῷ βιβλίῳ . . . γράφεται τὰ λεγόμενα Πλάτωνος ε̄ σχήματα, ἃ αὐτοῦ μὲν οὐκ ἔστιν, τρία δὲ τῶν προειρημένων ε̄ σχημάτων τῶν Πυθαγορείων ἐστίν, ὅ τε κύβος καὶ ἡ πυραμὶς καὶ τὸ δωδεκάεδρον, Θεαιτήτου δὲ τό τε ὀκτάεδρον καὶ τὸ εἰκοσάεδρον. τὴν δὲ προσωνυμίαν ἔλαβεν Πλάτωνος διὰ τὸ μεμνῆσθαι αὐτὸν ἐν τῷ Τιμαίῳ περὶ αὐτῶν.* Notes of this kind in the scholia to Euclid commonly go back through intermediate sources to the history of mathematics by Aristotle's favourite pupil Eudemus of Rhodes, and are thus of high authority.) Timaeus is not allowed to do more than make this vague allusion to the theorem. The inscription of the tetrahedron is directly mentioned at 55 a 3, and that of the dodecahedron by implication at 55 c 5. Both these inscriptions, according to the tradition, are 'Pythagorean', and they are the only two which receive special mention.

The argument that the *οὐρανός* is spherical because all the regular polyhedra can be inscribed in the sphere is presumably to Plato himself, like a good many things in the dialogue, no more than a playful fancy but Timaeus may be meant to take it quite seriously; as Aristotle said,

the Pythagoreans were always trying to see 'likenesses of their numbers in everything (*Met.* A. 985^{b} 27 *ἐν δὲ τοῖς ἀριθμοῖς ἐδόκουν θεωρεῖν ὁμοιώματα πολλὰ τοῖς οὖσι καὶ γιγνομένοις*).

33 b 1. τὸ πρέπον καὶ τὸ συγγενές. The spherical figure is *πρέπον* for the mathematical reason which Timaeus goes on to state in the next clause; it is *συγγενές* because, as we are told at b 6, it is the 'most complete and uniform' of figures and the *οὐρανός* is one (*ἕν*) and *ζῷον τέλεον*.

33 b 4–5. σφαιροειδές . . . ἀπέχον. There is possibly a conscious echo of Parmenides' description of *his* 'one real being', *τετελεσμένον ἐστὶ | πάντοθεν, εὐκύκλου σφαίρης ἐναλίγκιον ὄγκῳ, | μεσσόθεν ἰσοπαλὲς πάντῃ* (R. P. 120). Timaeus does not accept the 'singularism' of Parmenides, but he so far sympathizes with his criticism of the earlier Pythagoreanism as to make his own *οὐρανός* one, finite, and spherical. If the poem of Parmenides was composed in the author's early life, it would be known to Timaeus from his own earliest days, and we should expect to find that its trenchant criticisms have had their influence on his own version of Pythagoreanism.

33 b 7. μυρίῳ κάλλιον ὅμοιον ἀνομοίου. The point is that the sphere is a surface, as the circle is a plane curve, of *constant* curvature, and the only such surface known to Plato and the ancients generally, who had never heard of negative curvatures and the 'pseudo-sphere'. The Greek representation of the planetary orbits by 'circles' was by no means so arbitrary as is often said. Not only are the actual orbits of the major planets much more like circles than like anything the 'plain man' would call an ellipse or oval, but from the point of view of method it was the only right course to adopt the simplest hypothetical path compatible with the facts as already observed.

33 c 1–34 a 7. The figure could be made exactly spherical because there was no need to supply the *οὐρανός* with organs of sense, locomotion, respiration, nutrition, or evacuation. There is nothing outside itself for it to see, hear, touch, &c., and therefore it needs no sensory apparatus. And it has no need for a respiratory system, as there is no air outside for it to inhale.—**c 4.** This is an allusion to the doctrine of Anaximenes, who held that an *οὐρανός* keeps up its life by 'breathing in' *ἀήρ* from the 'boundless *ἀήρ*' outside it (*EGPh.*^{3} 73, R. P. 24). Pythagoras adopted the same doctrine, identifying *ἀήρ* at once with darkness and with what we should call 'empty' space. Hence the allusions in Aristotle to the Pythagorean doctrine that the *οὐρανός* 'inhales' (*εἰσπνεῖ*) the *κενόν* or 'void' which 'keeps bodies apart' (*διορίζει τὰς φύσεις*) from the 'boundless void' outside (Aristotle, *Physics* Δ. 213^{b} 23, R. P. 75a, already quoted). It was with special reference to the theories of Anaximenes and Pythagoras on this point that Xenophanes of Colophon thought it worth while to remark that though the 'world' is alive all over, it does not breathe (Diog. Laert. ix. 19, R. P. 103c *ὅλον δ' ὁρᾶν καὶ ὅλον ἀκούειν* (sc. *τὸν θεόν*), *μὴ μέντοι ἀναπνεῖν*). Timaeus is correcting the founder of his order.

Again (**c 4–6**), the *οὐρανός* needs no organs for taking in nutriment or excreting waste products. The decay of some parts of it provides the

τροφή which supports others, so that it lives, so to say, like a hibernating animal, by the consumption of its own fat. This must be the case if there is only one οὐρανός and nothing whatever 'encompassing it' outside. In the systems of the old Ionian cosmologists who believed in a 'boundless' which 'encompasses' the countless 'worlds', each οὐρανός 'lives on' the stock of the 'boundless'. According to Timaeus the one οὐρανός itself 'encompasses' (περιλαμβάνει, περιέχει) everything, so there are no 'provisions' outside on which the οὐρανός can draw. Yet again, since there is nothing for it to lay hold of, the οὐρανός needs no hands to grasp with, and as for the other function of the hand, to repel an enemy, that also is superfluous for a similar reason (**d 3–5**). And it needs no feet to walk with nor to stand on, because of the seven possible 'motions' it has only the one most appropriate to intelligence, uniform rotation on its own axis. Hence, as a whole, it always fills the *same* space and so needs no feet (**33 d 5—34 a 7**). Of course on the theory of Timaeus, there *is* no space outside into which it could move, and thus it *can* only rotate on an axis, if it is to move at all, as being a ζῷον it must.

33 d 1. ἐκ τέχνης. The words are meant to lay it down expressly that the arrangement by which the decay of some things provides the nutriment of others is not due to an unaccountable 'ultimate inexplicability', not 'arbitrary' (ἐκ τύχης), but a result of deliberate design, of divine goodness working for a wise purpose. Plato is quite in earnest in believing in this presence of genuine design in the universe. The failure to recognize design in the universe is the chief fault alleged against the old cosmologists in *Laws* x (889 b 1 πῦρ καὶ ὕδωρ καὶ γῆν καὶ ἀέρα φύσει πάντα εἶναι καὶ τύχῃ φασίν, τέχνῃ δὲ οὐδὲν τούτων . . . 892 b 6 τὰ δὲ φύσει καὶ φύσις, ἣν οὐκ ὀρθῶς ἐπονομάζουσιν αὐτὸ τοῦτο, ὕστερα καὶ ἀρχόμενα ἂν ἐκ τέχνης εἴη καὶ νοῦ). The wording of these passages shows that Plato is thinking of the saying of Polus of Agrigentum, quoted by Aristotle at *Met.* A. 981ª 4 ἡ μὲν ἐμπειρία τέχνην ἐποίησεν, ἡ δ' ἀπειρία τύχην. He takes this to mean that τέχνη, purposive intelligent contrivance, is a purely human invention (cf. αὐτὴν θνητήν in the first passage quoted above from *Laws* x), based on man's accidental observation of the course of events. Against this he sets his own view that if ψυχή is the source of all movements, 'nature' itself must be a product of τέχνη, 'design' which is not human but divine. Many modern 'idealists', though maintaining in words that mind is what they call the *prius* of everything else, are unwilling to admit genuine 'design' in nature, and talk of the order of things as 'quasi-purposive' or '*de facto* teleological', i. e. as somehow bringing about results which 'have value' but were never really planned. This was not Plato's opinion. In the words καὶ ὑφ' ἑαυτοῦ πάσχον καὶ δρῶν we have what the grammarians not very accurately call a 'zeugma', though it is really rather an 'ellipsis'; with δρῶν we have to supply mentally εἰς ἑαυτό 'acting on itself and being acted on by itself'.

33 d 2. αὔταρκες ὄν. We must not exaggerate the force of the words. No γιγνόμενον is αὔταρκες, according to the doctrine of Timaeus, in the sense of being what Spinoza calls *causa sui*, being self-explanatory, the *raison d'être* of itself; all γιγνόμενα are produced by that which ἔστι, γένεσιν δὲ οὐκ ἔχει. The οὐρανός is αὔταρκές τι merely in the sense just explained,

that it does not interact with any γιγνόμενον outside itself; all such interactions are interactions between one part of it and another part.

33 d 3. χειρῶν δὲ . . . χρεία τις ἦν. The 'anacoluthon' arises from the taking of the words χρεία τις ἦν into a relative clause. Timaeus begins as though he meant to say χειρῶν δ' οὐ χρεία τις ἦν and then varies the construction so that the genitive is finally left hanging in the air. These 'pendent' cases, most commonly nominatives or accusatives, are specially frequent in Plato's latest dialogues. Presumably their occurrence is intentional. The more nearly Plato approaches the style of the lecturer, the more anxious he is to avoid the fatal tendency to make what professes to be talk actually 'read like a book'.[1]

33 d 5. τῆς περὶ τὴν βάσιν ὑπηρεσίας, 'support to stand on', βαίνειν meaning to 'take one's stand' as well as 'to go'. Cf. *Politicus* 270 a 8 where the κόσμος is said ἐπὶ μικροτάτου βαῖνον ποδὸς ἰέναι, 'to move planted on a very tiny πούς', the πούς meant being, of course, the centre of the sphere (not, as Campbell says, the South celestial pole).

34 a 2. τῶν ἑπτά. The six κινήσεις which are here denied of the οὐρανός are not specified, but they are evidently the same three pairs often mentioned by Aristotle, up-down (ἄνω, κάτω), forwards-backwards (πρόσω, ὀπίσω), right-left (ἐπὶ δεξιά, ἐπ' ἀριστερά), as the possible directions of rectilinear motion. Any rectilinear movement which is not one of them can always, in virtue of the principle of the parallelogram of velocities, be resolved into components which do lie along three axes perpendicular to one another. So that the meaning is that the only regular movement left for the οὐρανός is rotation on a fixed axis, the 'eternal circular movement' (κυκλοφορία) which has no 'opposite' and in which, according to Aristotle, the world's yearning after God finds its expression (*Met.* Λ. 1072^{b} 3 ff.). The seven κινήσεις would be to Timaeus an illustration of that cosmical significance of the number 7 insisted on by the Pythagoreans and laughed at by Aristotle (*Met.* N. 1093^{a} 13 ἀλλὰ διὰ τί αἴτια ταῦτα; ἑπτὰ μὲν φωνήεντα, ἑπτὰ δὲ χορδαὶ ἢ ἁρμονίαι, ἑπτὰ δὲ αἱ πλειάδες, ἐν ἑπτὰ δὲ ὀδόντας βάλλει (ἔνιά γε, ἔνια δ' οὔ), ἑπτὰ δὲ οἱ ἐπὶ Θήβας).

34 a 8–b 9. οὗτος δὴ πᾶς . . . ἐγεννήσατο. A brief recapitulation of what has been said so far. The body of the οὐρανός was made spherical and all-inclusive for the reasons we have given. A soul was added to this body and so there came to be the one and only οὐρανός, always rotating on its own axis, without mate or fellow, in the fruition of its divine felicity.

[1] A.-H. takes the same view of the grammar here. Stallbaum regards χειρῶν as a 'partitive' genitive = *de mains*, translating *etwas von Händen* and saying that a τι is to be 'supplied'; and quoting 65 d 6 προσεπιλαμβανόμενα ὥστε ἀποτήκειν αὐτῆς τῆς φύσεως, *Sophistes* 232 b 2 ἀλλ' ἀναλάβωμεν (Bt. follows Heindorf in adding ⟨ἓν⟩) πρῶτον τῶν περὶ τὸν σοφιστὴν εἰρημένων; *Iliad* Ξ 121. On 65 d 6 he adds *Rep.* 485 b 1 and *Gorgias* 514 a 6, with a general reference to Matthiae *Gk. Grammar* § 323. This is a possible view, but the supposed construction seems to me much harsher here than in any of the places referred to by Stallbaum or quoted in Matthiae. The nearest parallel would be the *Sophistes* passage, but here the loss of ⟨ἓν⟩ after ἀναλάβωμεν would be so natural that I cannot help feeling that Heindorf's correction ought to be adopted. And the position of χειρῶν as the very first word of the clause seems to me decisive in favour of A.-H.

34 b 2. τέλεον ἐκ τελέων σωμάτων, i. e. the *οὐρανός* contains all the body there is, and each of its four component 'roots' is the whole of the fire, air, water, or earth there is. That the *οὐρανός* has a *ψυχή* as well as a body has been already implied by saying that it is a *ζῷον*, so that we are not as yet dealing with a new point. What is precisely the point of the statement that God not only put a *ψυχή* 'into' the cosmic body but 'wrapped it' (the *ψυχή*) round the world 'on the outside'? There were numerous and very different views held in antiquity which have been duly discussed by Proclus, but are not plausible enough to require detailed examination here. Proclus himself, following his immediate teacher Syrianus, took the general sense to be that the 'soul of the universe' has a supramundane element in its constitution and also a plurality of *δυνάμεις*, activities, diversely exhibited in different localities. Hence Timaeus leaves some of the cosmic *ψυχή* 'outside' the *πᾶν*, by way of insisting that it is, in the fashionable language of to-day, 'transcendent' as well as 'immanent'. It is a simpler explanation, and more on the lines of the earlier interpreters reported by Proclus, to say that the *ψυχή* is 'put into' the body of the *οὐρανός* to indicate that it is present as the initiator of movement wherever there is movement at all, i. e. throughout the universe; it is 'wrapped round' the *οὐρανός*, because Timaeus is thinking of the supposed diurnal revolution of the outermost heaven as the most uniform and orderly of all movements and thus as most fully revealing the presence of an intelligent *ψυχή*.

34 b 10–c 6. It must not be inferred from our having first spoken of the formation of the body of the *οὐρανός* and then of the soul which God 'put into it' that this represents the real order of creation. In speaking as we did, we fell into a neglect of accuracy and order which is one of our human infirmities. The world did not begin by being a body and then become a *living* body. We ought to have put the soul first, because soul comes before body *γενέσει καὶ ἀρετῇ* 'in order both of becoming and of worth'. (This need not be taken to mean that there ever was a time when the world was a soul without any body. In the *Laws*, x 895 b, the 'movement which moves itself' is equally said to be proved by the argument about the dependence of all bodily movement on the 'motions' of a soul to be *πρεσβυτάτην καὶ κρατίστην μεταβολὴν πασῶν, τὴν δὲ ἀλλοιουμένην ὑφ' ἑτέρου, κινοῦσαν δὲ ἕτερα δευτέραν*. But nothing is said anywhere in that argument about any temporal priority of cause to effect. All that has been insisted on is that 'imparted motion' is always dependent on internally initiated movement. So here 'first in order of becoming' need not mean first in order of time; it means first in the ontological order, the order of dependence.) Soul should properly be treated before body because it is the independent, body the derivative thing, and because it is 'first in value'. It was made to be the body's queen (*δεσπότιν*); the body is only an instrument for effecting the ends of the soul. It is in strict accord with this principle that we find the later Platonists (e. g. Proclus in his commentary on *Alcibiades* I), insisting that the true Platonic definition of *ἄνθρωπος* is *ψυχὴ σώματι χρωμένη*, and objecting alike to definitions which simply identify *ἄνθρωπος* and *ψυχή* and to those which do not expressly indicate the *instrumental* relation in which *σῶμα*

stands to ψυχή. (The second objection is raised e.g. against the Aristotelian definition.)

35 a 1–b 3. τῆς ἀμερίστου . . . μεμειγμένην. *The constitution of the soul of the οὐρανός.* We now come to the most perplexing and difficult passage of the whole dialogue, a passage of which the meaning was matter of disagreement betwen Xenocrates and his pupil Crantor, the author of the first commentaries on the dialogue. Since Xenocrates and Crantor could differ widely about the whole meaning, we may fairly assume that from the beginning there was no certain Academic tradition. Plato, then, had not given any explanation of his meaning, and from the first all exegesis must have been conjectural. Hence we must not be surprised if our own attempts to discover what is meant only conduct us to probable conjectures. And we are in a much less favourable position than men like Crantor and Xenocrates, or even Posidonius in the first century B.C., for framing probable conjectures. Much that would be intelligible at once to the first generation of the Academy, and even familiar to Posidonius from his learned researches, is dark to us from the loss of the literature which might have thrown light on fifth-century Pythagoreanism, and we are exposed to the danger of reading into Plato a host of ideas derived from sources extraneous to the Greek philosophical tradition. For these reasons it does not seem profitable to me to spend time on purely modern attempts to ascertain Plato's meaning independently of the ancient tradition; even if we find that there are insuperable difficulties in the way of the solutions proposed by early students who had access to the information we lack, we are not likely to arrive at a reasonable interpretation ourselves except by a careful study of their views. The materials for such a study fortunately exist partly in the essay of Plutarch on the passage entitled περὶ τῆς ἐν Τιμαίῳ ψυχογονίας, partly in the commentaries of Chalcidius and Proclus.

Of course the language in which Timaeus describes the making of the world's soul by the mixing together of certain ingredients in a κρατήρ or mixing-bowl, the vessel in which wine and water were blended at parties, the subsequent distribution of the product in accord with the intervals of a musical scale, and the cutting of it into strips which correspond to the celestial equator and ecliptic, is merely symbolical. What has suggested it is, as Bt. says, the Pythagorean conception of a musical scale (ἁρμονία) as a 'blending' (κρᾶσις) of the 'high and the low' (τὸ ὀξὺ καὶ τὸ βαρύ), according to definite mathematical ratios. This led on in medicine to the analogous conception of health in the body as a 'blend' or 'mixing' (κρᾶσις) of the different supposed ingredients of the body in the right ratios, the body being thus thought of as a sort of instrument of many strings which is in tune in health but out of tune in disease. Then the analogy was extended from the body to the soul, and this led to a host of familiar results. It led among the younger Pythagoreans, men like Echecrates in the *Phaedo*, to the view that the soul itself is just the tune or scale (ἁρμονία) given out by the body. This is why in the *Phaedo* Socrates has to refute that view and why Plato is careful by the by-play between Echecrates and Phaedo (*Phaedo* 88 c 8—89 a 7), to call our attention specially to the importance of this section of the dialogue. In

psychology the same analogy leads to the doctrine of the different 'temperaments' or 'attunements' (κράσεις) corresponding to the undue preponderance of one or other of the 'humours' in the body over the rest, a doctrine which has lasted almost down to our own times. In ethics it is the origin of the perpetual analogy which pervades both the *Republic* and the *Nicomachean Ethics* between virtue and health, vice and disease, and again between virtue and the correct attunement, vice and the false attunement, of a musical string. Our own language about 'idiosyncrasies', 'tonics', the physically and the morally 'bracing' and 'relaxing' is borrowed ultimately from the same source. Aristotle's famous ethical formula of the 'right mean' which is not absolute but relative comes, through the *Philebus*, from the same quarter. The 'relative mean' is plainly just the 'harmonic mean' on which the fundamental interval of Greek music, the διὰ τεττάρων or major fourth depends. (His insistence that the 'right mean' is not the 'arithmetic' mean would be intelligible at once to an educated hearer who would remember that the ratios corresponding to ground-tone, fourth, octave are 6, 8, 12 and that the octave or διὰ πασῶν consists of two intervals of a fourth. Thus the διὰ τεττάρων may be said to be 'half' the octave, but 8 is not 'half-way' between 6 and 12.) Our own literature is crammed with conscious and unconscious echoes of all these things. Thus Ophelia is talking pure Pythagoreanism when she compares Hamlet's mind in its morbid condition with 'sweet bells jangled, out of tune and harsh'. So in astronomy, it is the Pythagorean discovery of the ratios corresponding to the great musical intervals that leads at once to the theory that the heavenly bodies give out notes, the pitch of which depends on their distance or on their velocity,—the miscalled doctrine of the 'harmony' (it should be 'melody') of the 'spheres' (but they were not supposed to be 'spheres' before the time of Eudoxus in the fourth century). We must keep the tuned string and its applications before our minds through the whole of the following passage. It explains at once why the Demiurge is said to make the soul by blending ingredients, as a given musical tone is made by a 'blending' of 'the high' and 'the low', why he then goes on to distribute it over the universe in obedience to the law of formation of a series corresponding to a certain musical scale, and why all this is finally brought into connexion with an astronomical theory.

To begin the more detailed study of the passage with a few remarks about the text and grammar. We must clearly omit the untranslatable words αὖ περί or πέρι in 35 a 4. They make no intelligible sense and seem to have got in by inadvertence from the αὖ περί of 35 a 2. The error must have been an ancient one, as it has affected all our MSS. and nearly all the ancient quotations. Cicero may have known the correct text, as he does not translate these words. (Chalcidius also does not render them.) Also Sextus Empiricus (c. A. D. 200) quotes the passage (S. E. *adv. Grammaticos* 301) without them, not quite exactly, thus τῆς ἀμερίστου καὶ ἀεὶ κατὰ ταὐτὰ ἐχούσης οὐσίας καὶ τῆς περὶ τὰ σώματα μεριστῆς τρίτον ἐξ ἀμφοῖν συνεκεράσατο οὐσίας εἶδος, τῆς τε ταὐτοῦ φύσεως καὶ τῆς θατέρου. He alludes to the passage again in another place (*Hypotyp. Pyrrhon.* iii. 189) in a way which seems to ignore the intrusive αὖ πέρι (or περί), κρᾶσιν τῆς

ἀμερίστου καὶ μεριστῆς οὐσίας καὶ τῆς θατέρου φύσεως καὶ ταὐτοῦ. (His immediate source in this passage is Stoic, pretty certainly the commentaries of Posidonius, so that we may, perhaps, infer that Posidonius also had the text without the second αὖ περί.) The corruption is thus older than Plutarch, who recognizes it (unless his MSS. have been themselves corrected into conformity with a false text of Plato), but probably later than Cicero. Some MSS. may have been free from it in the time of Chalcidius (fourth century A. D.) and it was not universal in that of Sextus. As for the grammar, the genitives τῆς ἀμερίστου οὐσίας and τῆς μεριστῆς ⟨οὐσίας⟩ depend on ἐν μέσῳ, and γιγνομένης is emphatic and contrasted with ἀεὶ κατὰ ταὐτὰ ἐχούσης (so C. W.). Thus the first clause means literally 'midway between the being which is indivisible and always the same and the being which becomes (or "passes") and is divisible in the bodily region, he blended a third form of being compounded of them both, that is, of Same and Different'.

As for the περὶ τὰ σώματα of 35 a 2, it is an instance of the use of περί c. accus. to avoid an accumulation of genitives, a use very common in Plato's later style. The meaning is simply 'transient and divisible corporeal being'. Note that, as the substantive to be supplied with γιγνομένης μεριστῆς must be οὐσίας, we have here by implication a second denial of the absolute antithesis between οὐσία and γένεσις.

35 a 5–6. καὶ κατὰ ταὐτὰ . . . μεριστοῦ. Should we read τὰ αὐτά from Eusebius (and probably F, which writes ταυτὰ), with Bt., or κατὰ ταῦτα with the other MSS. and most editors? It does not appear from Cicero's version what the text before him was. Chalcidius clearly read κατὰ ταὐτά as he has *eodem modo*. As for Proclus, his latest editor Diehl represents him as reading κατὰ ταῦτα (though the MSS. are divided in the *lemma*), but I think it is plain from his comment (Diehl ii. 156. 18 and ib. 23) that he really read and wrote κατὰ ταὐτά. Indeed in ii. 156. 18 Diehl has to corrupt the text by foisting in a καί in order to make sense. (One should simply print, with the correct punctuation and accents, λέγει γὰρ ὅτι καθάπερ ἐπὶ τῆς οὐσίας καὶ ἐπὶ τῆς ταὐτοῦ φύσεως καὶ τῆς θατέρου τρίτον ἐξ ἀμφοῖν συνεκεράσατο, καὶ κατὰ ταὐτὰ καθάπερ ἐκεῖ τὸ ἐξ ἀμφοῖν οὐσίας εἶδος ἦν, οὕτω καὶ ἐν τούτοις ταὐτοῦ καὶ θατέρου τὸ μέσον εἶδος ἦν. 'Plato says that as in the case of Being, so also in that of Same and Different he blended a composite of both terms, and exactly as in the former case the composite was a Form of Being, so in this case, too, the intermediary between Same and Different was a Form.') The case is even plainer at ii. 156. 23. ἵν' οὖν μὴ τοῦτο λάθῃς ὑπονοήσας, τὸ καὶ κατὰ ταὐτὰ προσέθηκεν, ἵνα καὶ ἐνταῦθα τὸ ἐξ ἀμφοῖν εἶδος ᾖ καὶ μὴ ὅλον, 'to keep us from falling into this mistake he adds καὶ κατὰ ταὐτά, to make it clear that here, too, the resultant is a Form and not a whole'. ταὐτά should obviously be read in both passages. Plutarch is made by his modern editors to write κατὰ ταῦτα in the formal quotation of the whole passage with which his essay *de procreatione Animae* opens, but this proves nothing at all, and there is nothing in his comments to show how he understood the words. Ancient evidence thus seems to be on the side of κατὰ ταὐτὰ, 'and in like manner made it a compound (put it together) midway between that of them which is indivisible and that which is divisible in bodies'. This

seems a repetition of what had been already said three lines above, but has a point if the object of the clause is to remind us that the Same and Different of a 4–5 are identical with the Indivisible and Divisible of a 5–6.

35 a 6–8. καὶ τρία λαβὼν . . . βίᾳ, 'and he took the three of them and blended them all into a unity, forcing the Other into combination with the Same in spite of its reluctance to combine'. μίαν ἰδέαν is here a mere periphrasis = ἕν τι, a common idiom in Plato. Cf. *Philebus* 65 a 1.

35 b 1–3. μειγνὺς δὲ . . . μεμειγμένην, 'and mingling them by the help of Being' (τῆς οὐσίας = the οὐσία which has already been described as itself a blend of the other two factors) 'and having made one of three, he next (πάλιν) went on to divide the whole into as many portions as was meet, each part being a mixture of Same and Different and Being'.

Thus the operation the Demiurge is pictured as performing is clear enough. He first takes two ingredients *A* and *B* and by blending them produces an 'intermediate' *C*. He then makes a single uniform whole by blending *A*, *B*, and *C* and finally he divides that whole into a number of 'portions'. The difficulties begin when we ask exactly what all these proceedings are meant to symbolize. In considering the question, we must, I think, begin by insisting on a point which has often been overlooked. The whole passage has not to do with the formation or structure of ψυχή in general but more particularly with the ψυχή of the Universe as a whole. Any interpretation which assumes that we are dealing with a *mere* psychological analysis which we could verify in ourselves or our fellow-men is in danger of being wide of the mark. At the same time, since the general character of a ψυχή is to be found in all ψυχαί, or, as Timaeus himself will put it, since all *our* ψυχαί are made of the same ingredients and on the same plan as that of the οὐρανός, though none of them are of equal quality with it (41 d 4–7), we must expect to discover in the ingredients out of which the Demiurge fashions the world-soul characters of mind which do correspond to those we can detect in our own minds, or to some of them. With this in mind we may now consider what light is thrown on our passage by the Platonic tradition, so far as we can still trace it.

It is convenient to begin with a passage from Plato's most illustrious immediate disciple, Aristotle. The words which immediately concern us are these (*de Anima* A. 404^{b} 16 τὸν αὐτὸν δὲ τρόπον καὶ Πλάτων ἐν τῷ Τιμαίῳ τὴν ψυχὴν ἐκ τῶν στοιχείων ποιεῖ· γιγνώσκεσθαι γὰρ τῷ ὁμοίῳ τὸ ὅμοιον, τὰ δὲ πράγματα ἐκ τῶν ἀρχῶν εἶναι). Aristotle has just been saying that in general those of his predecessors who thought of the ψυχή primarily as a thing which 'perceives and knows', held that it is made of the same ultimate constituents as the objects which it knows, on the strength of an assumed general principle that 'like can only be known by like'. He adds that Plato in the *Timaeus* adopts the same position. 'In the same fashion, Plato too in the *Timaeus* makes the soul out of the "elements", for (he holds that) like is known by like and that the things (known) are formed from these principles.' We must distinguish here

between what Aristotle says about the actual statements of the *Timaeus* and what he gives as his own explanation of Plato's reasons for making the statements. What he definitely ascribes to Plato as the doctrine of the *Timaeus* is simply that 'the soul is made' of the στοιχεῖα. The further assertion that the reason for asserting this is that 'like is known by like' is an explanation of his own, based, no doubt, on the ground that in his account of the organs of sense Timaeus follows Empedocles in this matter, and that the same principle is assumed throughout the famous passage about knowledge and its object in the *Republic* (vi. 507–11). The exegesis is sound enough, but it is interpretation, not testimony. By the στοιχεῖα of which the ψυχή is 'made' Aristotle means not the Empedoclean 'four roots' but the ultimate factors, the ἀρχαί, of which Plato himself or his spokesman Timaeus believes the objects of our knowledge to be composed;[1] the πράγματα, again, mean, not 'things' in the plain man's sense of bodies, but the 'objects', whatever they may be, of which the ψυχή has knowledge (a common use of the word both in Plato and in Aristotle). The sentence thus reveals itself as a comment on the general sense of 35 a, that the soul is somehow constituted of two forms of οὐσία, that which is 'indivisible' and 'always self-same' and that which is 'divisible and transient in the bodily region'. These are the στοιχεῖα of which Aristotle is speaking, and his meaning is that according to Plato since the soul is to apprehend both ὄντα and γιγνόμενα it must itself combine the characters of Being and Becoming (in some way it must itself exhibit 'passage', and yet in some way it must be permanent and above 'passage'). Aristotle then goes on (loc. cit. 404^b 18–22) to add some statements about Plato's personal teaching intended to show its agreement with the *Timaeus* on the principle that 'like is known by like'. 'It was similarly determined in the discourses on Philosophy, as they are called (ἐν τοῖς περὶ φιλοσοφίας λεγομένοις), that the archetypal living being (αὐτὸ τὸ ζῷον), is constituted of the Form of One (ἐξ αὐτῆς τῆς τοῦ ἑνὸς ἰδέας), and of the first length, the first breadth, and the first depth (καὶ τοῦ πρώτου μήκους καὶ πλάτους καὶ βάθους), and similarly with the rest (τὰ δ' ἄλλα ὁμοιοτρόπως).' The reference is said by the ancient commentators to be to the famous lecture on 'the Good' in which Plato explained his own ripest speculations. We may take it that Aristotle, who was present at the lecture and published notes of it, has reported correctly what Plato said, but he has not offered any explanation of the statement about the αὐτὸ τὸ ζῷον, and we cannot therefore be sure either what he himself understood Plato to mean or whether he understood him correctly. We can see that there is an obvious connexion with the Pythagorean 'tetractys' (the series 1, 2, 3,

[1] I say 'or his spokesman, Timaeus' because all that Aristotle is entitled to urge as proof that the *Timaeus* goes on the principle 'like is known by like' is that Timaeus constructs the soul and the objects it knows out of the same στοιχεῖα. Whether the στοιχεῖα employed by Timaeus are the same as those which Aristotle goes on to refer to as used by Plato ἐν τοῖς περὶ φιλοσοφίας λεγομένοις or not is quite a different question, and one on which Aristotle is silent. He may have thought that they are the same, though if he did think so, it is singular that he makes no attempt to prove the point. And if he thought this, he may have been right or he may not.

4), but whether 'the first length, the first breadth, and the first depth' actually mean the integers, 2, 3, 4, as we should naturally infer from the mention of 'the Form of 1', or whether, as is in my own opinion less probably held, these words mean geometrical concepts derived from but not identical with those of the integers (so L. Robin in his essay *La Physique dans la Philosophie de Platon*, 1919, and his earlier *magnum opus* *La Théorie Platonicienne*, 1908), Aristotle's references do not enable us to decide with absolute certainty. (See, however, the notes on the passage in Aristotle *de Anima*, ed. R. D. Hicks.) The object of the allusion is simply to point out that in Plato's oral teaching, as in the *Timaeus*, the soul was said to be composed of the same factors as the objects of knowledge. It was not necessary for this purpose that Aristotle should encumber himself with a discussion of the precise character of the στοιχεῖα to which he refers. It is odd, however, that he does not seem to see that a statement about the αὐτοζῷον (which is admittedly a Form or εἶδος) is not, on the face of it, any evidence for Plato's views about the ψυχή (which is not a Form). Presumably the implied argument is that since all ζῷα have ψυχαί, their common archetype must have a 'Form of ψυχή'. It may be worth while to note in passing that Aristotle carefully distinguishes between what Plato said in his lectures and what is found in the *Timaeus*, so that we have here one of the many indications that we must not assume that the dialogue may be treated simply as a revelation of Plato's own convictions. Aristotle next goes on to add (loc. cit. 404^{b} 22) that the same thing (as that for which he has referred to Plato's lectures) 'has been put in another way (ἔτι δὲ καὶ ἄλλως). For Mind (νοῦς) is 1, Science (ἐπιστήμη) 2, because it goes by a single route to a single goal (μοναχῶς γὰρ ἐφ' ἕν); the number of the plane (i.e. 3) is Belief (δόξα), that of the solid (i.e. 4) is Sense. For though the numbers were said to be the actual Forms themselves, that is, the ultimate principles, still they (the numbers) are derived from the elements (οἱ μὲν γὰρ ἀριθμοὶ τὰ εἴδη αὐτὰ καὶ αἱ ἀρχαὶ ἐλέγοντο, εἰσὶ δ' ἐκ τῶν στοιχείων). And as the soul was held to be a principle of movement as well as cognitive in these ways (καὶ κινητικὸν καὶ γνωριστικὸν οὕτως), some combined the two and defined the soul as a *number which moves itself* (ἀριθμὸν κινοῦνθ' ἑαυτόν)'. These last observations hardly concern us here, as they are not particularly relevant to the discussion of the *Timaeus*. Indeed, it is not clear whether this 'other way' of putting the matter is intended to be ascribed to Plato or only to Xenocrates, the author of the definition of the ψυχή as a 'number which moves itself'. Thus Aristotle's references tell us no more about the *Timaeus* than what is obvious, that it describes the soul as combining the characters of the ἀεὶ κατὰ ταὐτὰ ἔχον and the γιγνόμενον, and that, in Aristotle's opinion, it is given these two characters on the ground that it knows and apprehends both the permanent and the mutable, and what knows must be *like* that which it knows.

We may now turn to the interpretations of Xenocrates and Crantor, which apparently divided the earlier Academy between them. These are most fully known to us from the discussion of them by Plutarch in his essay on the passage before us. As the only other interpretation of which he has anything much to say is that of Posidonius, we may reasonably

infer that these three were the only systematic attempts to explain the subject down to the end of the first century A.D. From what we know of Plutarch's methods of composition, it would, I think, be rash to suppose that he had studied the actual writings of Xenocrates or Crantor. It is more likely that he knew them through the medium of Posidonius, whose commentary appears to have been very full and learned. (Sextus Empiricus *adv. Logicos* i. 99, in his long attempt to show the impossibility of a 'criterion' of true and false, expressly quotes the work as an authority on the views of the Pythagoreans about the 'criterion' as proof that the school held the doctrine that 'like is known by like'.)[1]

Xenocrates, head of the Academy from 335 to 314 B.C., held that the definition of the soul is that it is a 'number which moves itself' (*ἀριθμὸς αὐτὸν κινῶν*), and he extracted that doctrine from our passage. That is, he maintained that what Timaeus is really describing under the name of the 'making of the world's soul' is primarily the logical derivation of the series of natural integers (Plut. op. cit. 1012 d–e *οἱ μὲν γὰρ οὐδὲν ἢ γένεσιν ἀριθμοῦ δηλοῦσθαι νομίζουσι τῇ μείξει τῆς ἀμερίστου καὶ μεριστῆς οὐσίας*). Accordingly he identified the Indivisible with the limit or number 1, the Divisible with Plurality or Multitude (*τὸ πλῆθος*) and held that T.'s object is to explain how the series of integers can be logically derived from these two ultimate 'indefinable notions' (op. cit. 1012 e *ἀμέριστον μὲν γὰρ εἶναι τὸ ἓν μεριστὸν δὲ τὸ πλῆθος, ἐκ δὲ τούτων γίγνεσθαι τὸν ἀριθμὸν τοῦ ἑνὸς ὁρίζοντος τὸ πλῆθος καὶ τῇ ἀπειρίᾳ πέρας ἐπιτιθέντος*). More precisely, the Divisible was identified with the 'indeterminate duality' (*ἀόριστος δυάς*). Apparently Xenocrates habitually called the element of multitude which is spoken of by Aristotle in his account of Plato's theories about number (*Met.* A. 987^{b} 20) as the 'dyad' of the great-and-small, the *ἀόριστος δυάς*, and to judge from the criticisms of the *Metaphysics* he confused this mere possibility of augmentation and decrease with the *number* 2. (At least Aristotle's arguments against the Academic doctrines turn repeatedly on this confusion.[2]) As for the successive steps of the Demiurge in first mixing two factors to produce a resultant and then mixing both a second time with this resultant, Xenocrates gave the following explanation. The first blending (of 1 with the 'indeterminate duality') produces 'number'. But the *ψυχή* is not merely a number, it is a 'number which can move itself' and other things. It has thus to be an *ἀρχή* of rest and motion. Consequently two more factors have to be introduced into its constitution[3] to serve as

[1] That the interpretations of Xenocrates and Crantor were the only two known to the early Academy seems to follow from the words of Plutarch op. cit. 1012 d *ἐπεὶ δὲ τῶν δοκιμωτάτων ἀνδρῶν τοὺς μὲν Ξενοκράτης προσηγάγετο, τῆς ψυχῆς τὴν οὐσίαν ἀριθμὸν ὑφ' ἑαυτοῦ κινούμενον ἀποφηνάμενος· οἱ δὲ Κράντορι τῷ Σολεῖ προσέθεντο, μιγνύντι τὴν ψυχὴν ἔκ τε τὴν νοητῆς καὶ τῆς περὶ τὰ αἰσθητὰ δοξαστῆς φύσεως· οἶμαι τι τὴν τούτων ἀνακαλυφθέντων σαφήνειαν ὥσπερ ἐνδύσιμον ἡμῖν παρέξειν.* Plutarch plainly knew of no other interpretation older than that of Posidonius.

[2] I do not need to discuss here either the precise character of the Academic derivation of the integers or the minor question whether the expression *ἀόριστος δυάς*, so often used by Aristotle, was peculiar to Xenocrates or had been employed by Plato. For full discussion and careful collation of the relevant texts the reader may be referred to Robin *La Théorie Platonicienne*.

[3] The point becomes clearer on a comparison with Aristotle *de Anima* A. 403^{b} 25 ff.

ἀρχαί of motion and rest, viz., ταὐτόν, Sameness or Permanence, and θάτερον, Variety, Difference. This gives us the complete character of ψυχή, that it is a number which is a cause of motion and rest.[1]

Crantor gave a wholly different explanation which started, not with mathematics, but with 'epistemology'. He held that the distinctive work of ψυχή is to make judgements about objects, objects of thought and objects of sense alike, and about the likenesses and differences to be found in objects of both classes, both among themselves and relatively to each other; that the ψυχή may acquire knowledge of all these, 'it has been blended out of them all, that is, out of four things, the intelligible which is eternally self-same, that which is acted on and undergoes change in the realm of body, and further of the Same and the Different because otherness and sameness are found in both of the two elements just mentioned.'[2] That is, the soul must have 'the indivisible' in it in order to apprehend the eternally unchanging objects of pure thought; it must have the 'divisible' to perceive the mutable things of sense; it must have sameness and diversity in itself because we recognize both these characters alike in the realm of pure thinking and in that of sensation. The assumption is thus tacitly made by Crantor, no less than by Xenocrates, that 'like is known by like'; the differences between them are that (1) Crantor is content to regard ψυχή as 'aware of things' without attending to its character as a 'source of motion'; (2) he says nothing about the theory that a ψυχή is a 'number'. Both interpretations, as Plutarch says, decline to take the 'production' of the soul literally as a process in time (*πάντες οὗτοι χρόνῳ μὲν οἴονται τὴν ψυχὴν μὴ γεγονέναι, πλείονας δὲ δυνάμεις ἔχειν, εἰς ἃς ἀναλύοντα θεωρίας ἕνεκα τὴν οὐσίαν αὐτῆς, λόγῳ τὸν Πλάτωνα γιγνομένην ὑποτίθεσθαι καὶ συγκεραννυμένην, op. cit.* 1013 a). Plato proposes to relate how it was made θεωρίας ἕνεκα, merely as a way of helping us to understand its οὐσία (what it is) by an analysis of its δυνάμεις, 'powers' or 'faculties' (what it does). But Crantor's account does not really apply any more particularly to the 'soul' than

Aristotle observes that there are two obvious characters of ψυχή, κίνησις and αἴσθησις. It 'moves' things and it is aware of things. Some of his predecessors had fixed on *awareness* as the distinctive proprium of ψυχή, some on the initiation of movement; the definitive 'number which moves itself' is an attempt to combine both points of view. The soul is said to be a *number* because the distinction of one thing from another thing which lies at the bottom of counting is the simplest recognition of identity and diversity, the most elementary act of *knowing* there is, and since *what* we count are numbers, it is inferred, on the principle that 'like is known by like', that the mind itself is a kind of number. It is a number *which moves itself* because we see that it sets up movements in our bodies and those of other animals, and it was inferred that what sets other things moving must be itself moving.

[1] Plut. *op. cit.* 1012 f τοῦτον (sc. the integer series) δὲ μήπω ψυχὴν τὸν ἀριθμὸν εἶναι. τὸ γὰρ κινητικὸν καὶ τὸ κινητὸν ἐνδεῖν αὐτῷ. τοῦ δὲ ταὐτοῦ καὶ τοῦ ἑτέρου συμμιγέντων, ὧν τὸ μέν ἐστι κινήσεως ἀρχὴ καὶ μεταβολῆς τὸ δὲ μονῆς, ψυχὴν γεγονέναι, μηδὲν ἧττον τοῦ ἱστάναι καὶ ἵστασθαι δύναμιν ἢ τοῦ κινεῖσθαι καὶ κινεῖν οὖσαν.

[2] Plut. *op. cit.* 1012 f–1013 a οἱ δὲ περὶ τὸν Κράντορα μάλιστα τῆς ψυχῆς ἴδιον ὑπολαμβάνοντες ἔργον εἶναι τὸ κρίνειν τά τε νοητὰ καὶ τὰ αἰσθητά, τάς τε τούτων ἐν αὐτοῖς καὶ πρὸς ἄλληλα γιγνομένας διαφορὰς καὶ ὁμοιότητας, ἐκ πάντων φασίν, ἵνα πάντα γιγνώσκῃ, συγκεκρᾶσθαι τὴν ψυχήν· ταῦτα δ' εἶναι τέτταρα, τὴν νοητὴν φύσιν ἀεὶ κατὰ ταὐτὰ καὶ ὡσαύτως ἔχουσαν καὶ τὴν περὶ τὰ σώματα παθητικὴν καὶ μεταβλητήν, ἔτι δὲ τὴν ταὐτοῦ καὶ τοῦ ἑτέρου, διὰ τὸ κἀκείνων ἑκατέραν μετέχειν ἑτερότητος καὶ ταὐτότητος.

to any of the other things which are said in the dialogue to have been made by God. The whole *οὐρανός* and every part of it is composed of 'the intelligible and the sensible' just as much as the *ψυχή*.[1] Xenocrates' account is un-Platonic, for Plato *never* says that the soul is a number, but simply that it is a 'source and fountain of motion'.[2] To speak of it as formed *κατ' ἀριθμόν*, in accord with a numerical law (cf. 37 a 4 *ἀνὰ λόγον μερισθεῖσα καὶ συνδεθεῖσα*), no more implies that the soul *is* a number than to say that it is formed *καθ' ἁρμονίαν* implies that it is an 'attunement', a doctrine notoriously rejected in the *Phaedo*.[3] Also the use X. makes of the Same and the Different is not Platonic. He regards Sameness as the cause of Rest, Difference as the cause of Motion, whereas in the *Sophistes*, when Plato is discussing the *μέγιστα γένη* or principal categories, he reckons them as five, Being, Same, Different, Motion, Rest, and is careful to discriminate each from all the others. It is, therefore, un-Platonic to equate *ταὐτόν* with Rest and *ἕτερον* with Motion.[4]

These comments are most pertinent and we may add others to them. Xenocrates, as Plutarch said, is confusing the doctrine that Forms (*εἴδη*) are numbers, referred to in Aristotle's *Metaphysics*, with that of the soul as expounded in the *Phaedrus* and *Laws*. It is the Forms or Numbers of which Aristotle says that Plato held that they were composed of two factors, the One and the Great-and-Small or 'indeterminate dyad'. The definition of *ψυχή* is simply that it is *ἡ αὐτὴν δυναμένη κινεῖν κίνησις*, i.e. the source of internally initiated movement. And a *ψυχή* is not a Form but a particular existent. X. had, so far as we can see, no warrant for throwing together the analysis of *εἴδη* and the statements of the *Laws* about the *ψυχή*.[5] Plutarch is also justified in his complaint of the use to

[1] Plut. *op. cit.* 1013 b–c *ἡ μὲν γὰρ ἐκ τῆς νοητῆς καὶ τῆς αἰσθητῆς οὐσίας λεγομένη μείξις οὐ διασαφεῖται πῇ ποτε ψυχῆς μᾶλλον ἢ τῶν ἄλλων, ὅ τι ἄν τις εἴπῃ, γένεσίς ἐστιν. αὐτός τε γὰρ ὁ κόσμος οὗτος καὶ τῶν μερῶν ἕκαστον αὐτοῦ συνέστηκεν ἔκ τε σωματικῆς οὐσίας καὶ νοητῆς.*

[2] Plut. *op. cit.* 1013 c–d *ἀριθμόν γε μήν ὁ Πλάτων οὐδέποτε τὴν ψυχὴν προσεῖπεν, ἀλλὰ κίνησιν αὐτοκίνητον ἀεὶ καὶ κινήσεως πηγὴν καὶ ἀρχήν· ἀριθμῷ δὲ καὶ λόγῳ καὶ ἁρμονίᾳ διακεκόσμηκε τὴν οὐσίαν αὐτῆς ὑποκειμένην καὶ δεχομένην τὸ κάλλιστον εἶδος ὑπὸ τούτων ἐγγιγνόμενον. οἶμαι δὲ μὴ ταὐτὸν εἶναι τῷ κατ' ἀριθμὸν συνεστάναι τὴν ψυχὴν τὸ τὴν οὐσίαν αὐτῆς ἀριθμὸν ὑπάρχειν· ἐπεὶ καθ' ἁρμονίαν συνέστηκεν, ἁρμονία δ' οὐκ ἔστιν, ὡς αὐτὸς ἐν τῷ περὶ Ψυχῆς ἀπέδειξεν.*

[3] Boeckh's interpretation (*Bildung der Weltseele, Kl. Schriften* iii. 131–3) is that of Xenocrates revived, as he himself admits. He virtually makes Timaeus teach the very doctrine refuted in the *Phaedo* that the soul *is* an *ἁρμονία*. Boeckh assumes this to have been the 'Pythagorean' doctrine, but, in truth, it was only *one* version of the Pythagorean doctrine, and not the original version (*EGPh.*[3] 295–6).

[4] Plut. *op. cit.* 1013 d–e *ἐκφανῶς δὲ τούτοις ἠγνύηται τὸ περὶ τοῦ ταὐτοῦ καὶ τοῦ ἑτέρου· λέγουσι γὰρ ὡς τὸ μὲν στάσεως τὸ δὲ κινήσεως συμβάλλεται δύναμιν εἰς τὴν τῆς ψυχῆς γένεσιν, αὐτοῦ Πλάτωνος ἐν τῷ Σοφιστῇ τὸ ὂν καὶ τὸ ταὐτὸν καὶ τὸ ἕτερον, πρὸς δὲ τούτοις στάσιν καὶ κίνησιν, ὡς ἕκαστον ἑκάστου διαφέρον καὶ πέντε ὄντα χωρὶς ἀλλήλων τιθεμένου καὶ διορίζοντος.* Cf. Plat. *Sophist.* 250 c 1 ff.

[5] It might be suggested that possibly Plato's *ἄγραφα δόγματα* afforded some warrant for X.'s combination. But in the passage cited from the *de Anima* at the beginning of this discussion, where Aristotle's express object is to show that Plato taught a certain theory about the *ψυχή* in these lectures, he only produces a statement about the *αὐτόζῳον*. If Plato had said anything of the kind about the *ψυχή*, it would have been much more to the point to have quoted it. Presumably then Plato said nothing of the sort.

which the *Sophistes* has been put, and he might have added that by distinguishing the Same and Different of our passage from the Indivisible and Divisible, X. has made five constituents of the ψυχή (or, if one chooses to forget that the blend of Divisible and Indivisible was again blended with its own original components, four), when Plato explicitly says there are only three.[1]

Crantor's interpretation also wrongly distinguishes the ταὐτὸν and θάτερον of our passage from the νοητὴ φύσις and σωματικὴ φύσις. He apparently overlooks the point that οὐσία is also an ingredient of the ψυχή and so makes the constituents four, whereas they should be three. And apart from the objection that everything else is at least as much as ψυχή a combination of the 'intelligible' and the 'sensible', and also is like some things and unlike others, there is the special difficulty, noted by Plutarch, that Timaeus expressly says that τὸ σωματοειδές is ὁρατὸν καὶ ἁπτόν, but ψυχή is not perceptible by sense at all. So that it seems peculiarly wrong-headed to interpret Timaeus in a way which makes him in effect teach that the soul is corporeal.[2] It would thus seem that the early Academic interpretations of the passage cannot be regarded as correct.

Plutarch himself thought that the root of the mischief was the one point of agreement between Xenocrates and Crantor, their denial that the γένεσις of the world and its soul are to be understood in a temporal sense. He admitted that his own view would be objectionable to most Platonists, but still proposed to follow Aristotle's lead and take the doctrine of 'creation in time' seriously. He points out that in words at least Timaeus refers to a period of blind chaotic motions *before* the Demiurge took the *indigesta moles* in hand (*Tim.* 52 d 2–53 c 3, *et alibi*). He connects this language with the myth in the *Politicus* about the alternation of periods in which God directly controls the world's movements with periods in which he 'retires to his conning-tower'[3] and leaves the vessel to welter as best it can in the sea of confusion,[4] and further with the distinction made by Timaeus himself between God the primary, and 'Necessity' the subsidiary, cause of the world-order (48 a 1, *alibi*). Plutarch's main interest is, as he does not try to conceal, an

[1] We have no right to assume that when Timaeus speaks of Same and Different he has the logical doctrines of the *Sophistes* in mind at all. These are represented by Plato as being expounded to Socrates in the last month of his life by an anonymous visitor from Elea. It would be hard to hint more plainly that they have no place in fifth-century philosophy.

[2] Plut. *op. cit.* 1023 a ἔπειτα τί διοίσει τῆς τοῦ κόσμου γενέσεως ἡ τῆς ψυχῆς, εἴπερ ἀμφοτέροις ἔκ τε τῆς ὕλης καὶ τῶν νοητῶν γέγονεν ἡ σύστασις; αὐτός γε μὴν ὁ Πλάτων, ὥσπερ ἀπωθούμενος τῆς ψυχῆς τὴν ἐκ σώματος γένεσιν, ἐντὸς αὐτῆς φησιν ὑπὸ τοῦ θεοῦ τεθῆναι τὸ σωματικόν (*Tim.* 36 d 9).

[3] *Politicus* 272 e 3 τότε δὴ τοῦ παντὸς ὁ μὲν κυβερνήτης, οἷον παιδαλίων οἴακος ἀφέμενος, εἰς τὴν αὐτοῦ περιωπὴν ἀπέστη.

[4] 273 e 1. God returns at fixed periods to the 'tiller' in time to save the world from complete shipwreck κηδόμενος ἵνα μὴ χειμασθεὶς ὑπὸ ταραχῆς διαλυθεὶς εἰς τὸν τῆς ἀνομοιότητος ἄπειρον ὄντα πόντον δύῃ. (The MSS. apparently all read τύπον for πόντον, as do the editors, but πόντον is plainly right. Proclus, who several times quotes the words, regularly has πόντον, and the 'sea' is absolutely demanded by the imagery of the 'ship'. It is in fact simply the 'boundless' through which the οὐρανός is thought of as taking its course.

ethical one. He wishes to find in Plato some explanation of the evil in the world which will avoid making God responsible for it. Now, so far as Plato himself can be said to treat the problem of evil as soluble at all, his solution is given in *Laws*, x. 896 d 5–e 6, where we are told that just as orderly motions are due to good souls, so disorderly motions are due to bad souls, and therefore the 'best soul' cannot be the only soul there is.[1] Since there are disorderly motions there *must* be at least one soul besides the 'best' soul, and there *may* be as many others as the appearances require for their 'saving'. But Plutarch gets out of this simple statement, as Zeller did in the nineteenth century, the very different thought that there is a wicked world-soul, a principle of evil, or Manichaean 'bad god'[2] as well as the good God, and that this 'evil world-soul' is the source of all the evil in the world. (But the standing Platonic doctrine about evil, in the *Laws* as much as elsewhere, is that all choice of evil is due to 'ignorance'; the soul only chooses evil because it mistakes it for good. So, if there is a single soul which is fallible, that is enough to explain why there is some evil in the world.) Plutarch, however, got an 'evil principle' out of the *Laws* and, calling the myth of the *Politicus* to his aid, identified this evil principle with the 'necessity' spoken of by Timaeus and the *σύμφυτος ἐπιθυμία* which is said in the *Politicus* to direct the world in the periods when God leaves it to itself. The theory then works out thus. From all eternity the world was animated by a blindly appetitive soul which was the cause of chaotic and random movement. At a certain time God took this soul in hand. Hitherto it had been like an untuned and unstrung musical instrument; God now put the instrument into tune by making its *ψυχή*, the source of all its movements, orderly and intelligent,[3] in fact by making it into an *anima rationalis*. This primitive disorderliness of the world's soul is, according to Plutarch, what is meant in our passage by the Divisible and the Different. His words are 'In the *Philebus* he calls it infinitude (*ἀπειρία*), an absence of number and ratio which has in itself no limit or measure of defect and excess and difference and unlikeness; in the *Timaeus*, the element which is blended with the indivisible and said to

[1] *Laws* 896 d 10 *ψυχὴν δὴ διοικοῦσαν καὶ ἐνοικοῦσαν ἐν ἅπασιν τοῖς πάντῃ κινουμένοις μῶν οὐ καὶ τὸν οὐρανὸν ἀνάγκη διοικεῖν φάναι;—τί μήν;—μίαν ἢ πλείους; πλείους· ἐγὼ ὑπὲρ σφῶν ἀποκρινοῦμαι. δυοῖν μέν γέ που ἔλαττον μηδὲν τιθῶμεν, τῆς τε εὐεργετίδος καὶ τῆς τἀναντία δυναμένης ἐξεργάζεσθαι.*

[2] Not a 'devil' in the traditional Christian sense; the Christian 'devil' is not an evil world-soul, but a creature of God who was created good, and though fallen does not cease to 'have a great deal of good in him'. As St. Augustine puts it, Satan's *natura* is good, it is his *voluntas* which is depraved. (*De Civitat. Dei* xii. 1 Angelorum bonorum et malorum inter se contrarios adpetitus non naturis principiisque diversis . . . sed voluntatibus et cupiditatibus extitisse dubitare fas non est; *ib.* 3 sola ergo bona alicubi esse possunt, sola mala nusquam, quoniam naturae etiam illae, quae ex malae voluntatis initio vitiatae sunt, in quantum vitiosae sunt, malae sunt, in quantum autem naturae sunt, bonae sunt.)

[3] *op. cit.* 1014 c *ὁ γὰρ θεὸς οὔτε σῶμα τὸ ἀσώματον οὔτε ψυχὴν τὸ ἄψυχον ἐποίησεν, ἀλλ' ὥσπερ ἁρμονικὸν ἄνδρα καὶ ῥυθμικὸν οὐ φωνὴν ποιεῖν οὐδὲ κίνησιν, ἐμμελῆ δὲ φωνὴν καὶ κίνησιν εὔρυθμον ἀξιοῦμεν, οὕτως ὁ θεὸς οὔτε τοῦ σώματος τὸ ἁπτὸν καὶ ἀντίτυπον οὔτε τῆς ψυχῆς τὸ φανταστικὸν καὶ κινητικὸν αὐτὸς ἐποίησεν· ἀμφοτέρας δὲ τὰς ἀρχὰς παραλαβὼν . . . ἔταξε καὶ διεκόσμησε καὶ συνήρμοσε, τὸ κάλλιστον ἀπεργασάμενος καὶ τελειότατον ἐξ αὐτῶν ζῷον.*

become and to be divided in the bodily realm must not be taken to mean plurality of numerical units or geometrical points [this is urged against Xenocrates], or length and breadth [this refers to the view of Posidonius], for these belong more properly to bodies than to souls, but must be understood of that disorderly and indeterminate self-moving source of motion which he often names *ἀνάγκη*, though in the *Laws* he calls it in plain words a disorderly and maleficent soul. This is what soul was by itself, but it received intelligence (*νοῦς*) and reason (*λογισμός*) and sane attunement (*ἔμφρων ἁρμονία*) that it might become the soul of an ordered world (*κόσμος*).'[1]

Apart from Plutarch the only Platonist to interpret the *Timaeus* on these lines, so far as we know, was Atticus. Their explanation has in one respect a real merit. It recognizes that the doctrine of 'matter' as the cause of evil is quite un-Platonic. Plutarch rightly appeals to the *Laws* as making souls the causes of both good and evil, and correctly remarks that the account of 'the receptacle' of 'becoming', which Timaeus gives later on, makes it purely passive and forbids us to regard it as causing anything whatever. He also recognizes that justice has to be done to the Platonic passages where soul is said to be 'uncreate' (*ἀγένητον*) as well as imperishable, but thinks he reconciles them with his theory by the view that the *ψυχή* was always there, but was hopelessly disorderly, and so not the *ψυχή* of a *κόσμος*, until the Demiurge took it in hand. A final verdict on his exegesis is not possible until we have studied what Timaeus really has to say about the *ἀνάγκη* which Plutarch supposes to mean the primitive condition of what was to become in time the 'world-soul'.[2] But we can see at once that there are grave reasons for not admitting this interpretation. It is certainly not necessary to infer from the mere fact that T. describes the *γένεσις* of the soul that he believed there was a time when it did not exist. The distinction which has been drawn between *ὄν* and *γιγνόμενον* is simply one between what is complete and what is 'in the making', the independent and the derivative, and there is nothing in Plato to suggest that something may not be 'in the making' throughout all time. In fact we shall see that Timaeus actually says this about the *οὐρανός*. That the *ψυχή* is said in the *Phaedrus* and elsewhere to be *ἀγένητον*, again, actually suggests that we must not suppose that there ever was a time when it was not; the words do not naturally suggest that though there never was a time when the soul was not, there *was* a time when it was 'insane'. Further, if we are to

[1] *op. cit.* 1014 d–e *τὴν δὲ τῆς ψυχῆς ἐν Φιλήβῳ* [26 b 6] *μὲν ἀπειρίαν κέκληκεν, ἀριθμοῦ καὶ λόγου στέρησιν οὖσαν, ἐλλείψεως τε καὶ ὑπερβολῆς καὶ διαφορᾶς καὶ ἀνομοιότητος ἐν αὐτῇ πέρας οὐδὲν οὐδὲ μέτρον ἔχουσαν· ἐν δὲ Τιμαίῳ τὴν τῇ ἀμερίστῳ συγκεραννυμένην φύσει καὶ περὶ τὰ σώματα γίγνεσθαι λεγομένην μεριστὴν οὔτε πλῆθος ἐν μονάσι καὶ στιγμαῖς οὔτε μήκη καὶ πλάτη λέγεσθαι νομιστέον, ἃ σώμασι προσήκει καὶ σωμάτων μᾶλλον ἢ τῆς ψυχῆς ἐστιν, ἀλλὰ τὴν ἄτακτον καὶ ἀόριστον αὐτοκίνητον δὲ καὶ κινητικὴν ἀρχὴν ἐκείνην ἣν πολλαχοῦ μὲν ἀνόγκην, ἐν δὲ τοῖς Νόμοις ἄντικρυς ψυχὴν ἄτακτον εἴρηκε καὶ κακοποιόν· αὕτη γὰρ ἦν ψυχὴ καθ' ἑαυτήν, νοῦ δὲ καὶ λογισμοῦ καὶ ἁρμονίας ἔμφρονος μετέσχεν ἵνα κόσμου ψυχὴ γένηται.*

[2] There is a witty saying of Coleridge that 'nature' is not so much a 'goddess in petticoats' as a 'devil in a strait waistcoat'. This exactly hits off Plutarch's theory of the cosmic *ψυχή*. It is precisely a 'devil' which the Demiurge has put into the strait waistcoat of *μέτρον* and *πέρας*.

suppose that the Divisible was there before God took the ψυχή in hand, we must equally suppose the same of the Indivisible. If the uncreatedness of the Divisible really means that the disorderliness of the world's ψυχή, its irrational features, never began, we should equally take the uncreatedness of the Indivisible to mean that its good and rational features never began either. If we take the whole account of the 'creation' of ψυχή at a certain time as myth, we must suppose that the ψυχή, which the world has always had, has always had both the Indivisible and the Divisible as its components; if we take the account literally, the badness as well as the goodness must have been put into the ψυχή by the Demiurge when he blended its ingredients. So Plutarch's interpretation does not really achieve its purpose; it does not really relieve the Creator from any responsibility He may be thought to have for His creation.

Plutarch also discusses the interpretation of Posidonius. Though it has been doubted, it is indubitable that he means the famous Stoic Posidonius from Apamea in Syria, one of Cicero's chief authorities for Stoic doctrine. It was he more than any other one man who supplied the educated Romans of the end of the Republic and early days of the Empire with their current view of the general structure of the world, and it is mainly owing to his influence that the philosophy of such Roman stoics as Seneca and the Emperor Marcus is so highly Platonized and so different from the pedantic rigorism of Chrysippus. According to Plutarch, Posidonius thought that the Divisible of Timaeus means 'extension', or as Plutarch expresses it 'the being of the boundaries of bodies' (ἡ τῶν περάτων οὐσία). The οὐσία which is said to have been made by blending this with the Indivisible stands for what Aristotle tells us Plato called the 'mathematicals', (μαθηματικά), and regarded as intermediate between the purely intelligible (the Forms or Numbers), and the things we perceive by the senses.[1] Accordingly Posidonius defined ψυχή as 'the Form of the extended' (ἰδέα τοῦ πάντῃ διαστάτου) constructed in accord with a number which embraces a musical scale (ἁρμονία). For,' he said, 'the mathematicals stand between the ultimate intelligibles and sensibles, and likewise soul possessing as she does the eternity of the intelligibles and the mutability of the sensibles, has her being, as is fitting, intermediate between the two'. Plutarch objects that this interpretation is next door to materialism,[2] as it clearly is, and as we should expect it to be when we remember that

[1] *op. cit.* 1023 b–c δεξάμενοι τὴν τῶν περάτων οὐσίαν "περὶ τὰ σώματα" λέγεσθαι "μεριστὴν" καὶ ταῦτα τῷ νοητῷ μείξαντες ἀπεφήναντο τὴν ψυχὴν ἰδέαν εἶναι τοῦ πάντῃ διαστάτου κατ' ἀριθμὸν συνεστῶσαν ἁρμονίαν περιέχοντα· τά τε γὰρ μαθηματικὰ τῶν πρώτων νοητῶν μεταξὺ καὶ τῶν αἰσθητῶν τετάχθαι, τῆς τε ψυχῆς, τῶν νοητῶν τὸ ἀίδιον καὶ τῶν αἰσθητῶν τὸ παθητικὸν ἐχούσης, προσῆκον ἐν μέσῳ τὴν οὐσίαν ὑπάρχειν. (I take προσῆκον here to be accus. absol. 'as is fitting', and therefore do not feel the doubt expressed by Bernardakis about the soundness of the text.)

[2] *ib.* 1023 b ὅμοια δὲ τούτοις ἔστιν ἀντειπεῖν καὶ τοῖς περὶ Ποσειδώνιον· οὐ γὰρ μακρὰν τῆς ὕλης ἀπέστησαν. Proclus (ii. 152) mentions an Eratosthenes who similarly held that the soul contains τὶ καὶ ἀσώματον καὶ σωματικόν. Zeller seems to me right in holding that this is not the famous Erastosthenes of Cyrene, but a Neo-Platonist follower of Porphyry of whom there are other traces in late Neo-Platonic literature. Against views of this type I feel sure that Proclus is expressing Plato's own attitude when he says as sufficient refutation κρᾶσις γὰρ οὐκ ἄν ποτε γένοιτο ἀδιαστάτου καὶ διαστατοῦ καὶ ἀμερίστου καὶ σώματος.

Stoicism was a thoroughly materialistic doctrine. It makes the soul, which it defines as the *ἰδέα* of the extended, something indistinguishable from a geometrical solid. He correctly adds that it is not Platonic to call the soul a Form (*ἰδέα*) at all; Forms are unchanging, the soul is 'always moving'; they are 'unmixed with the sensible', the soul is 'confined in a body'; the Forms appear in the *Timaeus* as the models on which God fashions things, the soul as one of the things fashioned.[1] These are sound criticisms, and fairly dispose of the interpretation of Posidonius as it stands. Another criticism which Plutarch makes on both Xenocrates and Posidonius is also very much to the point. Neither, he says, can account for the fact, fully recognized by Timaeus, that we can form *true* judgements about things perceived by our senses. He means that if you say with Xenocrates that the soul is a 'number', this may explain (on the principle that 'like knows like') how you can make true propositions in arithmetic and know them to be true. If you say with Posidonius that the soul is the 'Form of the extended', this (on the same assumption) will explain our knowledge of geometrical truths, but you still have to account for true 'judgements of perception'.[2] To provide for these, Plutarch urges that the 'divisible' element in the *ψυχή* means 'the movement which belongs to opinion and imagining, and conforms to the object of sense', i. e. it is a 'motion of soul'. But if *this* is an underived ('eternal') factor in *ψυχή*, *ψυχή* clearly cannot be defined as a number nor as the 'Form of the extended'. Plutarch's own explanation then works out to this. Timaeus means to say that the soul possesses (*a*) thought, which apprehends the truths of pure exact science, (*b*) phantasy, the power to frame mental pictures which are in themselves chaotic and fluctuating, (*c*) the power to form *true* opinions about that which is presented through the senses, and it is this which is meant by the *οὐσία* said by Timaeus to stand midway between the other two.[3] In a word, he takes the three factors to be what are popularly called 'understanding', 'sensation *plus* fantasy', 'true belief'. On the merits of the analysis, which is, of course, logically independent of his further assumption that the *γένεσις* of the soul is a process in time, I make no remark for the moment.

The fragment called *Timaeus Locrus*, though of no great authority, may be consulted as some evidence of the way in which Plato was interpreted

[1] *op. cit.* 1023 c *ἀτοπώτερον δὲ τὸ τὴν ψυχὴν ἰδέαν ποιεῖν· ἡ μὲν γὰρ ἀεικίνητος ἡ δ' ἀκίνητος, καὶ ἡ μὲν ἀμιγὴς πρὸς τὸ αἰσθητὸν ἡ δὲ τῷ σώματι συνειργμένη. πρὸς δὲ τούτοις ὁ θεὸς τῆς μὲν ἰδέας ὡς παραδείγματος γέγονε μιμητής, τῆς δὲ ψυχῆς ὥσπερ ἀποτελέσματος δημιουργός.*

[2] *op. cit.* 1023 d *πρὸς δ' ἀμφοτέρους τούτους κοινόν ἐστι τὸ μήτε τοῖς πέρασι μήτε τοῖς ἀριθμοῖς μηδὲν ἴχνος ἐνυπάρχειν ἐκείνης τῆς δυνάμεως ἢ τὸ αἰσθητὸν ἡ ψυχὴ πέφυκε κρίνειν· νοῦν μὲν γὰρ αὐτῇ καὶ νοητικὸν ἡ τῆς νοητῆς μέθεξις ἀρχῆς ἐμπεποίηκε· δόξας δὲ καὶ πίστεις καὶ τὸ φανταστικὸν καὶ τὸ παθητικὸν ὑπὸ τῶν περὶ τὸ σῶμα ποιοτήτων, ὃ οὐκ ἄν τις ἐκ μονάδων οὐδὲ γραμμῶν οὐδ' ἐπιφανειῶν ἁπλῶς νοήσειεν ἐγγιγνόμενον.*

[3] *op. cit.* 1024 a–b *τὸ γὰρ νοερὸν ἡ φύσις ἔχουσα καὶ τὸ δοξαστικὸν εἶχεν, ἀλλ' ἐκεῖνο μὲν ἀκίνητον ⟨καὶ⟩ ἀπαθὲς καὶ περὶ τὴν ἀεὶ μένουσαν ἱδρυμένον οὐσίαν, τοῦτο δὲ μεριστὸν καὶ πλανητόν, ἅτε δὴ φερομένης καὶ σκεδαννυμένης ἐφαπτομένον ὕλης. οὔτε γὰρ τὸ αἰσθητὸν εἱλήχει τάξεως ἀλλ' ἦν ἄμορφον καὶ ἀόριστον, ἥ τε περὶ τοῦτο τεταγμένη δύναμις οὔτε δόξας ἐνάρθρους οὔτε κινήσεις ἁπάσας εἶχε τεταγμένας . . . ὅσα μὴ κατὰ τύχην τῷ βελτίονι περιέπιπτεν· ἐν μέσῳ γὰρ ἦν ἀμφοῖν καὶ πρὸς ἀμφότερα συμπαθὴ καὶ συγγενὴ φύσιν εἶχε, τῷ μὲν αἰσθητικῷ τῆς ὕλης ἀντεχομένη τῷ δὲ κριτικῷ τῶν νοητῶν.*

in the first century A. D. The paraphrase on the present passage runs, 'The soul of the *κόσμος* he made . . . a blend of indivisible form (*μορφά*) and divisible being (*οὐσία*), so as to be one blend of these two. With this he mixed two powers (*δυνάμεις*) as sources of motions, that of the Same and that of the Different, which latter being repugnant to mingling was not very easy to work into the blend.' Here we merely note that the identification of the Indivisible with *μορφή* betrays an uncritical attempt to read the antithesis of form and matter in its Aristotelian sense into Plato, and the view that the Same and the Different are a further pair of ingredients, introduced to get a source of motion and rest, comes, as we have learned from Plutarch, from Xenocrates.

Chalcidius appears in his translation either to be rendering very loosely or to have an inaccurate text. In 35 a 4, if he is translating accurately, he had before him instead of the words *τῆς τε ταὐτοῦ φύσεως [αὖ πέρι] καὶ τῆς τοῦ ἑτέρου καὶ κατὰ ταὐτὰ* something which gave the sense that as the Demiurge had made one *οὐσία* intermediate between the *ἀμερές* and the *μεριστόν*, *so* (*κατὰ ταὐτὰ*) he next made something which was a blend of Same and Different, set *this* midway between the *ἀμερές* and the *μεριστόν*, and then blended *these* three (Indivisible, Divisible, the blend of Same and Different) into one. But in that case what became of the *οὐσία* which is a blend of *ἀμερές* and *μεριστόν*? His version is from 35 a 5 on, eodemque modo ex gemino biformique natura, quippe cuius pars idem, pars diversum vocetur, tertium naturae genus commentus est, quod medium locavit inter individuam et item coniugatione corporea dividuam substantiam. This would make the pair Same-Different distinct from the pair Indivisible-Divisible. But it is not a possible rendering of our text. In his Commentary, the origin of the Soul (ortus animae) is the second of the topics discussed. The words about the blend of the divisible and Indivisible are explained thus (§ 27). The Indivisible means the Eternal and Incorporeal (individuam esse eam cuius generis sunt omnia aeterna et sine corpore, quae intelligibilia dicuntur); the Divisible is Body, for there are many bodies, but one and the same 'being' belongs to them all and is therefore properly said to be divided in them. In like wise God is said to have made a blend of the two. Ch. does not say what this blend is, but goes on at once to talk of the Same and Different. He illustrates their presence in things by saying that a man and a horse are of the *same* genus but of *different* species. God mixed all three, Same, Being (essentia, apparently = the blend of Indivisible and Divisible already mentioned), and Different together, with the result that 'Same is not only same but has Being (substantia), and something of Difference; Being, too, is at once Being, Same, Different; Different also is Different and Being and has something of Sameness' (§ 28). Here there is the same sort of difficulty as in the translation, only now it is the blend of Same and Different which seems to be left out by God in making the final result. The trouble arises from not seeing that Indivisible and Same, Divisible

[1] *Timaeus Locrus* 95 c *τὰν δὲ τῶ κόσμω ψυχὰν μεσόθεν ἐξάψας ἐπάγαγεν ἔξω, περικαλύψας αὐτὸν ὅλον αὐτᾷ, κρᾶμα αὐτὰν κερασάμενος ἔκ τε τᾶς ἀμερίστω μορφᾶς καὶ τᾶς μεριστᾶς οὐσίας, ὡς ἓν κρᾶμα ἐκ δύο τουτέων εἶμεν· ᾧ ποτέμιξε δύο δυνάμεις ἀρχὰς κινασίων, τᾶς τε ταὐτω καὶ τᾶς τῶ ἑτέρω, ἃ καὶ δύσμικτος ἐᾶσα οὐκ ἐκ τῶ ῥάστω συνεκίρνατο.*

and Different are alternative names for the terms of the same pair, so that there *is* only one 'intermediate'. If you start with two pairs you are bound to get two intermediaries, and, since Timaeus expressly says that there are only three ingredients in the final product, one of these two is superfluous. The explanation, moreover, as Plutarch said of that of Crantor, from which it seems to be derived, does not show why the result of the 'blending' should be ψυχή rather than something else. Ch. goes on to mention certain discussions about the meaning of the terms Indivisible, Divisible, the 'intermediate' Being. Does the Indivisible mean the Forms in the world of thought (speciem intelligibilis mundi = νοητὰ εἴδη), the Divisible, Matter (silva = ὕλη, Aristotle's indeterminate 'stuff', which is the 'substrate' of the world of becoming), and the blend of the two, 'Form' 'Structure' *in* actual things, (μορφή in Aristotle's sense)? Or does the Indivisible mean some superior kind of soul which is wholly 'free from matter', the Divisible, the vital principle common to animals and plants (Aristotle's θρεπτικόν), the 'blend', the 'rational' soul in man? (This suggestion clearly comes from a Stoic source, as it is based on the Stoic doctrine of the 'indivisibility' of the soul and its corollary that in *man* assimilation of food and reproduction are functions of his ἡγεμονικόν or 'ruling principle' as much as thinking and knowing are.) As Ch. goes on to say himself (§ 31) this last suggestion is manifestly out of place, because in the story, when God is making the ψυχή of the world there are as yet no animals or plants to be animated. So far there is nothing but God, the 'best soul' of the *Laws*; what is being described is the making of created soul generally, and it is absurd to represent ψυχή as being made by blending two different kinds of ψυχαί together. Ch. himself, however, ends by adopting this very solution.[1] He dismisses his own criticism by saying that after all Plato does not seriously mean that God made ψυχή; it was eternal and all God did was to reduce its disorderly motions to order. This is taken from Plutarch and Atticus, and what I have already said about the incoherency of Plutarch's view that the disorderly (but not the orderly) motions of soul are eternal will equally apply to Chalcidius. As for his further view that the Indivisible means a mind or intelligence which is not that of any one in particular (a sort of *Bewusstsein überhaupt*), the Divisible the vital principle (τὸ θρεπτικόν) and the 'blend' of them the *anima rationalis* (the λογικόν of Aristotle), it ought not to recommend itself to any one. We shall see, that Timaeus leaves no place in his story for a mere θρεπτικόν, and though the 'spirited' and 'appetitive' elements of the *Republic* reappear, they are nôt supposed to belong to the soul of the οὐρανός. The οὐρανός, as we have already been told, needs no nutriment and has no organs for its reception; it has no enemies to fear and therefore has no organs of self-protection. Thus,

[1] Chalcidius *Comment.*, § 29 (ed. Wrobel p. 94) gives the theory thus: an potius indiuiduam Plato substantiam censeat eminentiorem animam quae nulli sit incorporationi obnoxia cuiusque ueneranda puritas nulla corporis contagione uioletur, diuiduam uero substantiam illam animam dicat quae non solum cunctis animalibus sed etiam stirpibus et arboribus dat uitalem uigorem: ut sit ex his duabus conflatum tertium animae genus rationabile. Apparently this interpretation is not original, since he professes to be stating the views of *ueteres*, though without naming their authors.

having neither 'wants' nor 'competitors', it has no need for an *ἐπιθυμητικόν* or *θυμοειδές*. These are described, later in the story, as made by the subordinate gods (who at p. 35 do not even exist), when it becomes necessary to adapt the *human* soul to its sojourn in the body. Also Plato knows of no 'higher' soul (*anima eminentior*) than the 'reasonable soul'; it is in his scheme the most exalted kind of particular existent there is, and what is not a particular existent is not a soul at all.

Proclus discusses the passage at great length and with a great deal of psychological acumen. It is only unfortunate that most of his subtleties have no special relevancy to the text he is expounding. He begins by telling us that Theophrastus censured Plato severely for giving any account of the genesis of the soul, which Plato himself held to be really underived. To ask for a cause of the existence of soul, he said, was like asking *why* fire burns or snow cools us.[1] Proclus retorts that Theophrastus, as a *physicist*, is quite justified in treating a soul, which is a source of motion, as an ultimate fact and not asking for its *raison d'être*, since a physicist needs only to account for physical 'motions' and has solved his own problem if he can trace these motions back to another physical source. He need not ask where the source comes from. But Plato, as a theologian, has this more ultimate problem on his hands. Souls are the lowest members in a vast spiritual hierarchy which reaches upwards to the 'One' or 'Absolute' itself. Unless you hold, as the Neo-Platonists did not, that there is no Absolute and that 'souls' are philosophical ultimates, when you come to 'theology' you must ask about the derivation of the soul from its 'absolute' source. Now the simple fact that souls are not always fully active, but always have powers or faculties which they are not at the moment exercising, shows that souls are not the supreme reality. That must always be, as Aristotle has said,[2] actually all it is capable of being, a complete *ἐνέργεια*. Also, if souls were the ultimate reality, there could be nothing actual which is not soul or at any rate does not 'partake' of soul. But there is the great system of inanimate bodies; these are not souls, nor do they 'partake' of soul. Also the 'supreme' reality must be *one*, but there is a vast plurality of souls. Plato is therefore justified in trying to make us understand what kind of thing the soul is by 'anatomizing' it, just as a physiologist dissects a body to explain the structure and working of its internal organs. He is right in telling a story of its 'genesis' for this purpose, if we remember that by 'what becomes' he means in his own words, what is '*always* in the making' (*γιγνόμενον ἀεί*) and 'always receiving an unlimited power to be'. This is precisely the case with the soul. Its being is infinite but it does not enjoy that being all at once; its life is a succession. So we may say that, though in one sense it is without origin and has its being in eternity, in another it is derivative and has its being

[1] *In Tim.* ii. 120 (Diehl) *καὶ τῶν παλαιῶν τινες ἐπέπληξαν τῷ Πλάτωνι λέγοντες· οὐκ ὀρθῶς ἀρχὴν ἀρχῆς ἐπιζητεῖ καὶ γένεσιν ἀγενήτου πράγματος· . . . τοιαῦτα μὲν ὁ Θεόφραστος ἐπιτιμᾷ τῷ Πλάτωνι περὶ τῆσδε τῆς ψυχογονίας, οὐδὲ ἐπὶ τῶν φυσικῶν πάντων λέγων δεῖν ἡμᾶς ἐπιζητεῖν τὸ διὰ τί· γελοῖον γάρ, φησίν, ἀπορεῖν διὰ τί καίει τὸ πῦρ καὶ διὰ τί ψύχει ἡ χιών.*

[2] Arist. *Met.* Λ. 1072^{b} 27 *ἡ γὰρ νοῦ ἐνέργεια ζωή, ἐκεῖνος δὲ ἡ ἐνέργεια.*

in time. It is also true that the soul itself is threefold. It is not a pure unity without plurality, like νοῦς, intelligence, nor yet divisible *ad indefinitum*, as Proclus held bodies to be; it is a structure (ἁρμονία) with a unity of its own, but a unity in which we can discriminate three 'essential' factors (οὐσιώδη μέρη). We can distinguish in it, its being (οὐσία, what it *is*), its activities (ἐνέργειαι, what it *does*), its capacity for these actions, (its δύναμις). The being (οὐσία) of the soul, once more, is itself threefold. We can distinguish in it its 'bare being' (ὕπαρξις, being something and not nothing), its structure (ἁρμονία, the fact that it is a complex of these factors, as we have just been told), and its form (εἶδος, that which discriminates it from everything which is not soul). Altogether we get *five* ultimate factors of ψυχή; ὕπαρξις, ἁρμονία, εἶδος (its distinctive form), δύναμις (capacity), ἐνέργεια (activity). (The object of all this subtlety is to get a correspondence with the five μέγιστα γένη of the *Sophistes*, but the correspondence is forced and artificial.) Coming to the *Timaeus*, Proclus lays it down that the μέγιστα γένη (unity, sameness, otherness, motion, rest), must all be in some way in the soul, because if they were not the soul would not be able to recognize their presence in other things, (a version of the old dictum that 'like is known by like'.) We must also remember that Timaeus is describing the structure not of any and every soul, but specifically of the soul of the κόσμος, and this holds a definite place, neither the highest nor the lowest, in a great hierarchy of souls. In what Plato says, then, about the blending of the Indivisible with the Divisible, he is not referring to any 'capacity' or 'activity' of the soul, such as knowledge, but to its bare being (ὕπαρξις). What he has to say about 'knowledge' and other activities of the soul will be said later. He means by the Indivisible an intelligence or νοῦς. But he does not mean *any* νοῦς; he means *the* νοῦς which belongs to the κόσμος in particular. By the Divisible he means the 'bodily life' (ζωὴ σωματοειδής) which the soul of the κόσμος infuses into all its parts, and what he is saying is that the cosmic *soul* is the connecting link between the νοῦς or 'understanding' of the κόσμος and the organic life which the κόσμος enjoys. Now, understanding in its own nature is eternal and possesses truth once for all and all at once. But souls do not, as a fact, attend to all truths at once, but now to one and now to another. So the soul may be said to be at once eternal,—in so far as it enjoys intelligence—and a thing of time. It is thus the connecting link between the higher spiritual beings who are eternal *simpliciter* and the world of bodies, which are temporal *simpliciter* and not eternal at all. This is why Plato describes the Indivisible as 'always being in the same state' and the temporal as 'becoming in the bodily region', and why he is quite in earnest in speaking of the soul itself as something which 'becomes always'.

Proclus now sets aside a great many earlier interpretations. Of that of Xenocrates he remarks that since Timaeus has never hinted that the soul is a number, it would be absurd for him to give an analysis of number under the pretence of analysing the soul.[1] Like Plutarch he

[1] Proclus ii. 154 (Diehl) *ῥητέον ὅτι οὔπω τοῦ Πλάτωνος ἀριθμὸν ποιοῦντος τὴν ψυχὴν ἄτοπον ἀριθμοῦ ζητεῖν ἀρχὰς ἐξ ὧν ἐστι.*

rejects the type of view represented by Posidonius on the score of its materialism.[1] The view of Plutarch and Atticus is condemned on the ground that it makes the 'unreasonable' element in the soul prior to the reasonable, and we cannot suspect Plato of believing that.[2] Even the simple explanation given by Plotinus does not satisfy Proclus. Plotinus (*Ennead* iv. 2) explains briefly that the Indivisible means the intelligible, the Divisible the sensible. The soul is midway between the two, like the Indivisible in being present as a whole to every part of the body, (so e. g. if my finger is crushed 'I' feel it, and the 'I' is strictly indivisible), like the Divisible in so far as an *embodied* soul is aware only of the things which affect *one* organism. (When your finger is pricked, I have no feeling of it, though Plotinus holds that every *disembodied* soul is directly aware of all that affects every other.) Plotinus thus thinks that Plato's real object is to indicate the precise kind or degree of individuality which belongs to an *embodied* soul. Proclus's objection is that Timaeus is as yet speaking not about the knowledge of the cosmic soul but about its *essentia*, not about what it does, but about what it is.[3]

He now requires to discuss the clause about the Same and the Different, but, so far as I can see, really has nothing definite to say about it.

Ingenious and elaborate as Proclus's exegesis is, I do not see that it really helps us much. He is more anxious to find a justification for his own fancies about the hierarchy of spirits than to discover the actual meaning of Timaeus. And most of the subtleties which he develops are quite irrelevant, however interesting on their own merits.

Among modern editors Stallbaum is content to give it briefly as his own opinion that the Indivisible = the Same, and that both are names for the Forms or εἴδη, the Divisible = the Different = 'matter'. The obvious objections are (1) that 'matter' plays no part in the *Timaeus*, (2) that, like the view of Posidonius, that of Stallbaum really amounts to making the soul a sort of body, and this is quite incompatible with the sharp opposition which Timaeus maintains throughout his discourse between σῶμα and the ψυχή which is 'prior to body γενέσει καὶ ἀρετῇ'.

Martin discusses the passage at length (*Études sur le Timée* i. 346–383). He begins by remarking that both Cicero and Sextus Empiricus refer to our passage as a famous example of almost hopeless obscurity (Cic. *ad Atticum* vii. 13, Sextus Empiricus *adv. Mathematicos* i. 301). As far as Cicero is concerned, this is an oversight on Martin's part; Cicero's expression 'numero Platonis obscurius' refers to the famous 'number' of *Republic* viii. 546. Since the meaning was so obscure, even in antiquity, M.

[1] Proclus ii. 154 (Diehl) Πλάτων ἀσώματον εἶναί φησιν τὴν ψυχὴν καὶ ἁπλοῦν πρὸς πᾶν σῶμα παραβαλλομένην, καὶ αὐτοκίνητον ἔχειν οὐσίαν, οὐδὲν δὲ διάστημα τοιοῦτον.

[2] *ib.* τὴν ἄλογον οὐ βούλεται πρεσβυτέραν εἶναι τῆς λογικῆς· οὐ γὰρ ἄρχεσθαι πρεσβύτερον ὑπὸ νεωτέρου, καθάπερ εἶπεν, ὁ θεὸς ἠξίωσε.

[3] *ib.* οὐ περὶ γνώσεώς ἐστι ψυχικῆς ὁ λόγος, ἀλλὰ περὶ οὐσίας· οὐκ ἔδει οὖν μέσην αὐτὴν φάναι τῶν γνωστικῶν δυνάμεων, τῆς νοερᾶς καὶ τῆς αἰσθητικῆς. The view here rejected is ascribed generally to the 'more philosophical' interpreters, of whom only Plotinus is named, but in principle it is that of Crantor. Proclus's point is presumably that Timaeus does not reach his account of the γνωστικαὶ δυνάμεις until 37 a–c, and that it would be a fault of method to anticipate it at this stage.

does not hope to discover it with any certainty and is content to offer what he calls an 'eclectic' explanation which his readers may or may not approve. He begins by a discussion of the grammatical sense of the words. Unfortunately he retains the second *αὖ περι* and the pretty certainly false *κατὰ ταῦτα* in 35 a 5, and so is prevented from giving an accurate account of the actual words. His result, however, is sound enough on the main point that there are three and no more ingredients in the final 'mixture', and that one of the three is the *οὐσία* compounded of the Indivisible and the Divisible. He lays great stress on this point because he, (wrongly, as I think), understands Proclus to mean that the *essentia* of the soul is a blend of the Indivisible and Divisible and to have forgotten that this blend is expressly said at 35 b 1 to be mixed with two other ingredients before the *ψυχή* is finally made. Now, says M., it is nonsense to say that to make a certain thing you must blend the *essentia* of that thing with other components. This is counting in the thing itself as one of its own factors. Proclus consequently virtually treats the soul as having two factors, whereas Timaeus distinctly says that it has three. I think Proclus's theory far too subtle to be disposed of by this slap-dash criticism, though it is true that he passes too briefly over the latter part of the passage. M.'s own tentative explanation turns entirely on the meaning of the word *οὐσία* in 35 a 4, which is rendered *essence*. It is unfortunate that he does not see that *τρίτον οὐσιάς εἶδος* only means 'a third form of being', so that the words are really little more than a periphrasis for *τρίτον τι*, 'a third something'. M. is really dominated by the associations of the word *essentia* in medieval scholasticism. Accordingly he supposes by *οὐσία* here Plato means certain 'general notions' or 'abstract ideas' which are not themselves Forms (*εἴδη*), but only 'imitations' of them, and, unlike the *εἴδη*, are '*in* sensible things' and give them their specific characters. Thus he identifies *οὐσία* in effect with the scholastic *universalia in rebus*, the 'forms' which Aristotle recognizes in those passages where he attacks the view that there can be 'forms' which are not concreted in 'matter', but distinguishes it from what Plato calls the eternal unique *εἶδος*, the *universale ante rem*. He connects this distinction with what Aristotle says about Plato's distinction between *εἴδη*, *μαθηματικά*, and *αἰσθητά*. (Here I think he is on the right track, though he does not clearly understand what Plato meant and is pretty certainly wrong in supposing that the *word οὐσία* is being used in any abstruse or technical sense.) As his 'eclectic' explanation stands it is open to the objection that what the combination of matter and form in this Aristotelian sense yields is simply a *body* of some determinate kind, a rose, a horse, or the like. It is not intelligible how the doctrine extracted from the passage by M. can be put forward as an analysis of *ψυχή*. M. does not seem to see this. He defends his attribution of 'forms' in the sense of *universalia in rebus* to Plato by arguing that later on such 'forms' are said to be one of the constituents of the physical world, but it does not strike him that even if he were right in finding these 'forms' in the *Timaeus* as constituents of the bodily world, this ought to be an argument *against* the theory that they also figure as constituents of the *ψυχή*.

M. next asks, what are the Indivisible and the Divisible? Here again

he refers to the important statement of Aristotle about Platonism at *Met.* A. 987^b 14—988^a 1. What Aristotle says there is that Plato regarded the Forms or Numbers themselves as composed of two factors, the One and the Great-and-Small. M. asks, is the 'Indivisible' an 'imitation' of the One, the Divisible an 'imitation' of the Great-and-Small? But this time he sees that the consequence of the identification would be an un-Platonic materialism. The 'imitation' of the 'Great-and-Small' would be a 'continuum'; in fact, it would be the very thing of which we shall subsequently find the physical world to be made. M.'s own interpretation unfortunately follows Plutarch and Atticus in taking the things which Timaeus says about the condition of the world 'before' the Demiurge began his work, literally, and identifying the Divisible with the imaginary 'disorderly world-soul' falsely supposed to be spoken of in the *Laws*. As for the Indivisible, it has then to be taken as meaning the rationality which God 'put into' the soul of the world, and M. adds that this is an 'emanation of the Deity, i.e. the Deity Himself manifesting His powers more or less in the souls to which He brings light and order'. Here we may meet M. with his own line of argument against Proclus. According to Plato, God is a ψυχή, but obviously the ingredients of the cosmic ψυχή are not themselves ψυχαί, and therefore 'the Deity manifesting His powers' cannot be one of those ingredients.

Grote unfortunately passes the subject over without any examination in his account of the *Timaeus* (*Plato and the other Companions of Socrates* c. 38). The most eminent scholar of the nineteenth century who has attempted a discussion is August Boeckh who has a monograph (date 1807) on *The Formation of the World-Soul in Plato's Timaeus* (reprinted in Boeckh's *Gesammelte Schriften* vii. 109–180). Boeckh is chiefly concerned with the construction of the musical scale to which we shall have to turn directly, but he gives his opinion also about the general sense of the passage before us. He starts from the already quoted remark of Aristotle in the *de Anima*. He brings this into connexion with the statement of *Met.* A. that the στοιχεῖα of Plato's Forms are the One and the Great-and Small (or ἀόριστος δυάς). This latter he, like Aristotle, appears to confuse with the *integer* 2. Hence he identifies the Indivisible (=the Same) of Timaeus with 1 and the Divisible (=the Different) with 2, as symbols of unity and multiplicity respectively and infers that Xenocrates was right in regarding the ψυχογονία as concerned with the deduction of the integers. In fact, he simply accepts the Xenocratean account of ψυχή as a 'number which moves itself'. I hope it will be clear from what has gone before why I cannot accept this interpretation. As to Boeckh's exegesis of the sentences from the *de Anima*, it ought to be clear that if Aristotle meant what Boeckh takes him to mean, his statement cannot be regarded as legitimate exposition. There is nothing in the dialogue, except possibly one obscure hint, about numbers as the ultimate ἀρχαί of things; and about 1 and the 'dyad' as the ἀρχαί of numbers there is not even a hint, though it is precisely of *numbers* that these are the ἀρχαί according to Aristotle's account of Platonism in the *Metaphysics*. It is more reasonable then to suppose that Aristotle does not mean to say that Timaeus 'makes the soul' out of *these* ἀρχαί at all. He means that the

Indivisible and the Divisible (in fact the familiar Pythagorean Limit and ἄπειρον), are treated by Timaeus as the στοιχεῖα of the soul as well as of the things it apprehends. The further remark of Aristotle about what Plato said ἐν τοῖς περὶ φιλοσοφίας λεγομένοις must not be confused with what he says about the *Timaeus*. Timaeus derives ψυχή from the στοιχεῖα recognized in his own discourse. Plato also said ἐν τοῖς περὶ φιλοσοφιας λεγομένοις that the αὐτόζωον is composed of certain στοιχεῖα, but it does not follow that the στοιχεῖα of the account of Timaeus are identical with the στοιχεῖα of the περὶ φιλοσοφίας, nor even that Aristotle supposed them to be identical. All that his argument requires is that in both cases the στοιχεῖα assigned to the soul which knows things should be the same as those of the things which it knows. Rejection of Boeckh's interpretation must not be misconstrued into disrespect for his great eminence as a scholar. I think we shall have occasion to see that undue deference to Boeckh has stood and still stands in the way of right exegesis of the *Timaeus* in at least two cases besides the present; if it does, it is no right way to honour his memory to perpetuate mistakes which were more excusable a century ago than they are now. It is not the least service to scholarship of men of Boeckh's eminence that their own achievements enable their successors to correct their errors.

Archer-Hind's treatment of the subject is amateurish. He says that the Indivisible is 'pure mind', the Divisible, 'mind differentiated into material existence' (a phrase which is surely not Platonic, and may be suspected of being unmeaning). οὐσία he asserts to be only a name for the fact that thought and sense are activities of the same subject. This seems really little better than an evasion of serious discussion. A.-H. makes no reference to the divergent ancient theories about the passage and is apparently not alive to the difficulties which beset all attempts to interpret it in a critical and historical spirit.

Since none of the traditional explanations seems satisfactory, we must try tentatively to ascertain the meaning for ourselves by careful examination of the words of Timaeus. Once more, I must remind the reader that the immediate problem is not what Plato thought about the ψυχή, but what he has seen fit to make Timaeus say. We are not at liberty to reason as though Timaeus had read the 'works' of Plato, or even attended his discourse on 'the Good'. We are entitled to assume that Timaeus might allude to well-known fifth-century Pythagorean doctrine, or to fifth-century philosophical theories in general. It is taken for granted throughout that his auditors have the kind of scientific 'culture' which will enable them to follow such allusions. (53 c 1 ἐπεὶ μετέχετε τῶν κατὰ παίδευσιν ὁδῶν δι' ὧν ἐνδείκνυσθαι τὰ λεγόμενα ἀνάγκη, συνέψεσθε.) But it ought to be a canon of sound criticism that wherever he is asserting anything which goes beyond current fifth-century doctrine, his meaning must be made clear by his own language. The one Platonic dialogue on which he might, without absurdity, draw for anything which is outside these limits is the *Republic*, since Socrates is feigned to have repeated the contents of that work to him the day before. But even in using the *Republic* we must remember that Timaeus is an old and eminent man and is not very likely to be basing his exposition of his own views on

principles which he has learned only yesterday from a younger man. In the main, we must use Platonic dialogues in ascertaining his meaning only where they enable us to draw inferences about the ideas, especially the Pythagorean ideas, current at the opening of the last quarter of the fifth century.

This is not to say that we may expect to find Timaeus advocating any view which Plato regarded as merely false. Unless Plato had held that the Pythagorean science of men like Timaeus was in principle on the right lines, he would not have made Timaeus expound it with the approval of Socrates. But it may very well be that he has abstained from making Timaeus say about any given subject all that he might have said himself in his own name. We may reasonably expect to find in what Timaeus says correspondences with doctrines which we know Plato to have taught; we must be prepared at any rate to consider the possibility that there may be concealed hints of things which Plato has deliberately abstained from making a fifth-century speaker proclaim, but we have no right to go further. Primarily we must ascertain what Timaeus means to tell his auditors out of his own words read in the light of all that we know about contemporary Pythagoreanism.

Next we may take a step which simplifies the problem before us. We may take it as certain from the words of 35 a 6 *καὶ τρία λαβὼν κτλ.*, that there are just three and no more than three constituents of the world's *ψυχή*, and that one of them is the 'blend' of the Indivisible and Divisible. This shows that the Same and Different here spoken of must be identical with the Indivisible and the Divisible respectively. This does not, of course, mean that the Indivisible is the only subject of which you can assert sameness, the Divisible the only subject of which you can assert difference. Both sameness and difference can be asserted of any subject you please, and Timaeus is quite aware of this (37 b 3ff.) But that which is *always* the same (*ἀεὶ κατὰ ταὐτὰ ἔχον*) and that which is 'always becoming something but never finally *is* that something' (*ὄντως οὐδέποτε ὄν*), are the most striking examples of the prominence of sameness and difference respectively and may quite intelligibly be called the Same and the Different. (The logic of sameness and difference is explained fully in the *Sophistes*; we do not need to appeal to the *Sophistes* for anything Timaeus says. It is all matter of common sense and only has to to be argued out in the *Sophistes* because certain paradox-mongers had denied it. Timaeus betrays no sign of having heard of them or their paradoxes and it is not likely that he would have come across them at Locri. They are connected with the rise of formal logic at Athens and Megara.) We may be reasonably sure, then, that the ingredients of the *ψυχή* are just these three, the Indivisible (= the Same), the Divisible (= the Different), the blend of the two.

We can also simplify our task by explaining at once what is meant by saying the three were 'made into one'. Of course they were; they were made into one *ψυχή*. A little later on (37 a–c) we shall find references to the *ψυχή* as formulating judgements sometimes about that which always is 'in the same state', sometimes about that which changes, but it is one and the same *ψυχή* which formulates both sets of judgements.

There is not one ψυχή of me which judges that $9 \times 7 = 63$ and another which judges that one of the runners in a race I am watching is falling behind. It is this individuality of the ψυχή which Timaeus obviously has in mind when he speaks of the fusing of the three constituents, and it is the contrast between the individual unity of the judging ψυχή and the vast 'manifold of sense' out of which it has to elicit its judgements of perception that leads him to speak of the difficulty of the Demiurge's divine chemistry (δύσμεικτον οὖσαν, συναρμόττων βίᾳ.)

The whole problem, then, is to determine what Timaeus means by the Indivisible and the Divisible and the blend of the two. We may be quite sure that this is not to be understood in any way which could make the ψυχή either a number (Xenocrates) or a *res extensa* (Posidonius) for reasons which have appeared sufficiently already. We have to ask ourselves what a Pythagorean of the fifth century is likely to have meant by the Indivisible and the Divisible. And the answer to the question seems to be indicated by the statement of Aristotle that Plato in the *Timaeus* makes the soul ἐκ τῶν στοιχείων. This ought to mean that the soul in our passage is derived from *the* στοιχεῖα which Timaeus recognizes as the στοιχεῖα of the objects which the soul knows (as στοιχεῖα τῶν πραγμάτων), and these στοιχεῖα ought to be Pythagorean. Now we know from Aristotle himself what the στοιχεῖα of πράγματα were according to the Pythagoreans. They held, he says, that the στοιχεῖα of their numbers are the ultimate στοιχεῖα of all things (since, according to their belief, things are numbers, or are, at any rate 'likenesses of numbers'), τὰ τῶν ἀριθμῶν στοιχεῖα τῶν ὄντων στοιχεῖα πάντων ὑπέλαβον εἶναι (*Met.* A. 986ª 1). And the στοχεῖα of the numbers are two, the Unlimited and Limit (ἄπειρον and πέρας), or, as Aristotle puts it, rather less exactly, τοῦ δ' ἀριθμοῦ στοιχεῖα τό τ' ἄρτιον καὶ τὸ περιττόν, τούτων δὲ τὸ μὲν ἄπειρον, τὸ δὲ πεπερασμένον, 'the constituents of number are the Even and the Odd, the former being unlimited, the latter limited' (*ib.* 986ª 17). He goes on to say that the first thing formed by the combination of unlimitedness and limitedness is the unit, or 1, which is regarded as at once odd and even, and from the unit the integers are then developed (τὸ δ' ἓν ἐξ ἀμφοτέρων εἶναι τούτων, καὶ γὰρ ἄρτιον εἶναι καὶ περιττόν, τὸν δ' ἀριθμὸν ἐκ τοῦ ἑνός, *ib.* 986ª 19). Into the full significance of all this I need not enter here. It is enough to be reminded that, according to the Pythagorean doctrine, the ultimate components of all things are the ἄπειρον and the πέρας, and that 'the unit' is the simplest and earliest combination of them. This suggests that if Timaeus was understood by Aristotle to be 'making the ψυχή out of the στοιχεῖα', Aristotle recognized in his account of the soul's constitution the familiar Pythagorean antithesis of ἄπειρον and πέρας, in fact that the ἀμέριστον of our passage answers to πέρας and the μεριστόν to the ἄπειρον. If this is so, it is significant that the first step in the making of the ψυχή is the construction of a τρίτον οὐσίας εἶδος, just as, according to the Pythagoreans, the first result of the combination of the ἄπειρον and πέρας is the 'unit', and that there is then a further step to be taken before we reach the ψυχή, just as, according to the same school, the ἀριθμοί are got from 'the unit'. There would seem to be the closest corespondence between the generation of the Pythagorean 'numbers' from their στοιχεῖα and the

making of the cosmic ψυχή. This is exactly as it ought to be, if the doctrine that 'like knows like' is to be retained, for what the ψυχή knows is just the things which make up the οὐρανός, and the Pythagorean numbers *are* these things (ἀριθμοὺς δὲ, καθάπερ εἴρηται, τὸν ὅλον οὐρανόν, *loc. cit.* 986ᵃ 21). If this is the correct view to take of the passage, it follows at once that Plato is not here expounding his own theories. For whereas the Pythagoreans made the ἄπειρον and πέρας the ultimate στοιχεῖα of everything and 'the unit' the simplest combination of them, Plato, according to Aristotle, who had heard the theory expounded by Plato himself, said that the στοιχεῖα of number were the 'unit' and the 'great-and-small' (*Met.* A. 987ᵇ 20, ὡς μὲν οὖν ὕλην τὸ μέγα καὶ τὸ μικρὸν εἶναι ἀρχάς, ὡς δ' οὐσίαν τὸ ἕν). Aristotle himself is specially struck by the substitution of the μέγα καὶ μικρόν (a 'continuous range', as we should say) for the Pythagorean ἄπειρον, and calls this an ἴδιον of Plato, a feature distinguishing his teaching from the Pythagoreanism which, Aristotle held, it 'in the main agreed with' (τὰ μὲν πολλὰ τούτοις ἀκολουθοῦσα *Met.* A. 987ᵃ 30). But from a logician's point of view the really striking divergence is that with Plato 'the unit' has become itself an 'indefinable' or στοιχεῖον instead of being a derivative. If Timaeus is working with a theory in which the ultimate indefinables are still ἄπειρον and πέρας, he is speaking as a Pythagorean should speak, but not as an exponent of the doctrine known to Aristotle as Plato's. There is an exact parallel in the *Philebus*. As we all know, Socrates there is made to work throughout with the Pythagorean categories. The ἄπειρον of that dialogue is indeed described as comprising ὁπόσ' ἂν ἡμῖν φαίνηται μᾶλλόν τε καὶ ἧττον γιγνόμενα καὶ τὸ σφόδρα καὶ ἠρέμα δεχόμενα καὶ τὸ λίαν καὶ ὅσα τοιαῦτα πάντα (*Phileb.* 24 e 7), in fact as the μέγα καὶ μικρόν, 'that which admits of indefinite increase or diminution'. But the antithetical factor which blends with it to produce γενέσεις εἰς οὐσίαν is not 'the unit' but πέρας.

There can be only one plausible explanation of this curious fact. We cannot suggest that Plato had not developed his own view when he wrote the *Philebus*, since no one doubts that the *Philebus* is proved by its style to be one of his very latest works; while the way in which Aristotle talks of 'the' doctrine of Plato, is enough to show that the theories he describes were no whim of an old man in his last months but had been the standing doctrines of the Platonic Academy for the twenty years during which Aristotle was a member of it. And no one will suggest that the *Philebus* was written before 367, the year in which Aristotle entered the school. But we have to remember that the *Philebus* is laid in the fifth century. There is no indication of the supposed date beyond the fact that at 58 a 7 one of the speakers refers to what he 'used often to hear Gorgias say', so that the time must be taken to be later than the first visit of Gorgias to Athens in 427 B.C. Plato is under the necessity of making the discourse one in which Socrates might have taken part at any time during the last twenty-five years of his life. Hence he has to make his points by using not his own but the Pythagorean doctrine of the στοιχεῖα, which, as it happens, is perfectly adequate for the special purposes he has in hand. What he has thus done in the *Philebus* we may reasonably expect to find him doing also, for the same reason, in the *Timaeus*.

Our proposed method of interpretation, however, demands something more than the rediscovery of the Pythagorean *ἄπειρον* and *πέρας* in the 'psychogony'. It requires that the *στοιχεῖα* assigned by Timaeus to the *ψυχή* shall answer to *στοιχεῖα* into which Timaeus himself resolves 'objects'; he is to construct the *ψυχή* out of *his στοιχεῖα*, as Aristotle asserts that he does. What his *στοιχεῖα* are we do not see fully until we come to the analysis of physical things which runs from 48 e 2 to 53 c 3 of the dialogue. Here, however, we do find exactly what we are in search of. We are told that to account for the physical world we must distinguish three things, *ὄν*, *χώρα*, *γένεσις* (52 d 2) and not fewer. As to the character of the three, *γένεσις* has already been fully described as what we might call the emergence of a character in the physical world, and it has been assumed that this is revealed to us in sense-perception; *γένεσις* is the complex of *ταῦτα ἅπερ καὶ βλέπομεν, ὅσα τε ἄλλα διὰ τοῦ σώματος αἰσθανόμεθα* 51 c 1); it is, in fact, the 'ingredience of objects into events', by which the 'passage' of nature is constituted. About *ὄν* there is no difficulty either; we are told that *ὄντα* are permanent and unchanging, they are the *ὄντα ἀεί* of which what we call sensible realities are *μιμήματα* and are expressly identified with the famous Forms (*πάντα περὶ ὧν ἀεὶ λέγομεν οὕτως αὐτὰ καθ' αὑτὰ ὄντα ἕκαστα*, 51 b 8); in a word, they are what Whitehead calls 'objects', and the point of insistence upon their reality is that Nature is not made up of the mere succession of events, that the passage of nature is a process of 'ingredience' of objects into events; without objects, as without events, there would be no nature. The remaining member of the triad, *χώρα*, is shown by its very name to be the Pythagorean *κενόν* thought of as pure geometrical extension. This is what answers in Timaeus's construction of sensible things to the category of *ἄπειρον*. It is true that with the reduction of the number of *οὐρανοί* to one, we can no longer think of it as a 'boundless' 'encompassing' the *οὐρανός* on the outside, but it retains the character of being formless and structureless, the element of indetermination in things (*πάντων ἐκτὸς εἰδῶν*, 50 e 4, *ἀνόρατον εἶδός τι καὶ ἄμορφον, πανδεχές*, 51 a 7, *χαλεπὸν καὶ ἀμυδρὸν εἶδος ἐπιχειρεῖν λόγοις ἐμφανίσαι*, 49 a 3). While it is easy to say that the 'models' are apprehended by thinking, the 'copies' of them by sense, it is a problem which Timaeus finds a hard one to say how this 'matrix' (*ἐκμαγεῖον*) of becoming is apprehended at all, though as it is a constituent of the world which the mind apprehends, it must in some way be revealed to us. Thus we see that there is a definite correspondence between the triplicity of the *ψυχή* and the triplicity of the world it is cognizant of; it is because 'like is known by like' that, having a triplicity in ourselves we can find it in that which lies around us. If one treats an account of this kind too seriously, a difficulty arises at once. If the 'like' in us which 'knows' each constituent of the world around us is really identical in kind with that which it knows, the *ψυχή* must just be one more physical thing added to the rest, and as physical things are, according to the Pythagoreans, 'numbers', the *ψυχή* will be another 'number'. So we come, like Xenocrates, to the conclusion that Plato really means to teach that the soul is a '*number* which moves itself', and we shall find ourselves forced to explain away the unmistakable distinc-

tion between souls and the objects of their awareness. At most we must hold that there is an analogy or correspondence between the ἄπειρον, the πέρας, and the union of the two which are found in ψυχαί and the ἄπειρον, πέρας, and κρᾶμα into which we analyse the physical world. Timaeus, it is true, does not expressly say anywhere that the elements he detects in the ψυχή are only analogous, not identical, with those he finds in physical objects. But we must remember that it was characteristic of the school to which he belonged that they strained their original formulae, by liberal interpretation, to make them express ideas to which they were really inadequate. Aristotle comments on this when he says of them that the ἀρχαί they postulate are better adapted for the analysis of 'higher' objects than the physical things in which the Pythagoreans professed to detect them (*Met.* A. 990ᵃ 5, τὰς δ' αἰτίας καὶ τὰς ἀρχὰς ἱκανὰς λέγουσιν ἐπαναβῆναι καὶ ἐπὶ τὰ ἀνωτέρω τῶν ὄντων, καὶ μᾶλλον ἢ τοῖς περὶ φύσεως λόγοις ἁρμοττούσας). It is an illustration of the same point that we find Aristotle ascribing to the Pythagoreans both the cruder assertion that physical 'things' *are* numbers, and the more refined formula that they 'imitate' numbers. We are clearly dealing with an attempt to retain a formula which was only adequate so long as 'numbers' themselves were thought of as volumes, *res extensae*, made by persons who have really so far outgrown the formula as to be able to think of the 'number of a collection' as something different from the collection itself. We shall have opportunities, as we go on, to see that this is by no means the only case in which the theories of Timaeus are manifestly not adequate to the facts and not fully consistent with themselves, nor are we entitled in the most important of such cases (as I shall point out when I come to them), to assume that Plato was not alive to the inadequacy. In fact it is sufficient proof that he did not regard the Pythagorean theories which he employs in the *Timaeus* and *Philebus* as adequate that he notoriously substituted 'the unit' for πέρας as the fundamental antithesis to the ἄπειρον. Timaeus is meant to be expounding not a dead dogma but the principles of a science which is still *im Werden begriffen*; if it had been dead and stereotyped dogma, Platonism could not have grown out of it. A certain manifest want of absolute self-consistency in the 'system' is the price it pays for the flexibility which ensures its progressiveness.

If this is the true account of the matter, we shall see that of the ancient interpretations, that of Crantor has most nearly seized the central thought, and Proclus was fully justified in speaking of it as the most 'philosophical'. His own objection, that it is not in order to discuss the question of the γνωστικαὶ δυνάμεις of the soul until you have first analysed its οὐσία, is not really to the point. How can we discover what anything which moves and lives *is* except by starting from the consideration of what it *does*? The objection is, in fact, based upon nothing more than the identification of the οὐσία of a thing, with a ὑποκείμενον or 'substrate' *behind* the thing's activity. The one point in which we may fairly regard Crantor as being wrong is in his unfortunate attempt to make ταὐτὸν and θάτερον stand for something different from the νοητὴ φύσις and the σωματικὴ φύσις. He aims at this unfortunate distinction, apparently

because he is illegitimately attempting to credit Timaeus with the whole results of the logical investigations of the *Sophistes*.[1]

I have already argued that we are not to expect to find Timaeus formally expounding views about the ψυχή or anything else which had only been reached by Plato himself more than half a century after the supposed date of our dialogue. But we may expect to find a broad general agreement between his doctrine and things which are taught in the dialogues or even things which we know Plato to have maintained from the statements of Aristotle about his teaching. Thus the assumption that 'like is known by like', which Aristotle found in Plato's oral teaching is common enough in the dialogues and seems to have been as characteristic of both Socrates and Plato as of the Pythagoreans. It is the foundation of the whole scheme for training the souls of the young 'guardians' of *Republic* ii–iii into moral beauty by surrounding them with the loveliness which appeals to eye and ear. The main principle of this 'early education', that the soul inevitably grows like, takes on the character of, that which it contemplates is manifestly Pythagorean, for it is the foundation of the ethical teaching in the *Phaedo*, and Plato has been careful, as Bt. reminds us, to mark the Pythagorean character of the *Phaedo* by making two pupils of Philolaus, Simmias and Cebes, the chief interlocutors of Socrates as well as by 'dedicating' the whole work to a third Pythagorean, Echecrates. We may reasonably understand Timaeus to mean in what he says about the presence of the Indivisible and the Divisible in the ψυχή that when, on the one hand, it has sense-perceptions, it is aware of a scene of incessant and bewildering change and multiplicity; when, on the other, it studies what the Pythagoreans regarded as the highest objects of Science, numbers and their relations, it is contemplating a system which is outside the whole temporal flux, eternally and unchangingly self-same. Thinking, in its most 'abstract' form, and sense-perception will be the analogues in the ψυχή itself to the numbers studied in ἀριθμητική and to the apparently incessantly varied and infinitely divisible 'appearances' of sense. (There is a real analogy here, though we must not assume that Timaeus is aware of it. Sensation, in virtue of having 'intensity' *is* like a variable with a continuous

[1] The case, as I conceive it, then stands thus. The 'psychogony' of our dialogue is throughout Pythagorean, for it is based all through on the Pythagorean doctrine of the way in which first the 'limit' and then the series of 'numbers' are derived from ἄπειρον and πέρας. It is emphatically not Plato's own doctrine, as we see from the facts that nothing is said by Timaeus of what, according to Plato in the *Laws*, is fundamental fact about ψυχή, that it 'moves itself' (though Timaeus is allowed to use this phrase once later, 37 b 5, without explanation), and that 'the unit' does not figure as an ultimate in the derivation. Also, though Timaeus comes very near to making the ψυχή a number, he does not go the whole length. He *never* says anywhere that the soul or anything else *is* a number. He does in the end analyse physical things into volumes of extension with a certain geometrical shape, but he never goes behind his geometrical constructions to identify geometrical figures with 'numbers' as the earliest Pythagoreans had done. He clearly represents the form of the doctrine according to which 'things' are 'likenesses of numbers', not the simpler version which actually makes them 'numbers'. Xenocrates reached his exegesis by first ignoring this distinction and then crediting Timaeus with what we know from the *Laws* to be Plato's own definition of ψυχή.

range and so *is* really analogous with the 'divisible'; there would seem to be no meaning in talking about the greater or less 'intensity' of a judgement.)

Now we may go on to a further question. The ψυχή is not a mere blend of the Indivisible and Divisible. It contains this blend as one of its three ingredients. If the other two ingredients are meant to account for our knowledge of the properties of number and our acquaintance with the 'manifold of sense', we shall reasonably expect this third ingredient also to correspond to some γνωστικὴ δύναμις. And if we were right in seeing a parallelism between the components of ψυχή and the structure of the 'objective world', we must be able to work out this parallel in detail. There must be, in the world as known, something that corresponds to the 'blend' of Indivisible and Divisible which is used in the making of the ψυχή. What is this something? I venture to suggest the following very tentative exegesis. What we have to account for is that the 'contents of our minds' to use an ambiguous but convenient phrase, do not fall into two mutually exclusive compartments. We have not in mere juxtaposition a scientific knowledge of the laws of number, and also acquaintance, based on sense, with a mere chaotic jumble of 'appearances', such a 'manifold of sense' as Kant supposed it to be the business of the mind to reduce to order by imposing 'forms of intuition' and 'categories of the understanding' upon it. We actually do see order and regularity *in* the 'appearances'. They are what the *Philebus* calls γενέσεις εἰς οὐσίαν, and that is why we can discern laws and uniformities to which they approximately conform, and why science can progress by looking for a preciser formula when it has been found that the old one has not 'saved the appearances'. It is why in cosmology, though you never pass from the 'likely story' to the exactitude of scientific finality, one 'story' can be more 'likely' than another and why it is our duty to make our own story as 'like' the truth as we can. On what does this possibility of finding order *in* the 'appearances' depend? To answer the question completely one would need to anticipate all that we shall have to say about the corpuscular physics expounded in the central sections of the dialogue. But, to put it roughly, the answer which Timaeus gives comes to this. We can formulate 'laws of nature' because, in the last resort, the behaviour of bodies depends on the geometrical structure of their corpuscles, and geometry is a science no less than the theory of numbers is. We have here a thoroughly Pythagorean thought. A cosmology which is more than idle fancy is possible because *geometry* is the medium through which the laws of number become applicable to the world of colours, sounds, smells, and the like.

One or two remarks may be subjoined to avoid possible misunderstanding.

(1) In the account of the physical world we have a combination of a formless χώρα with the παραδείγματα or Forms which gives rise to γενέσεις, determinate *processes*; in the ψυχή the Indivisible (or Same) and the Divisible (or Other) produce when 'blended' not γένεσις but οὐσία. Thus the analogy between the constitution of the ψυχή and the constitution of the objects of its knowledge is not complete. This, I take

it, is because there is clearly some sense in which the mind which contemplates the passage of nature and knows it for 'passage' cannot be supposed to be itself 'passing' in the very act of recognizing 'passage' and transience for what they are. To recognize the transition from A to B as a transition, the mind must itself not have *that* transition within itself; it must contemplate it *ab extra*. And a mind which can recognize that the whole life of nature is 'passage' must in some way be itself above all 'passage'. The element in it which corresponds to and knows γενέσεις εἰς οὐσίαν must itself be not a γένεσις εἰς οὐσίαν but an οὐσία. This conception is not an easy one to grasp. The difficulty is that in some sense the mind itself clearly does 'partake of passage'; it is because we find mutability in ourselves that the thought or the spectacle of the mutability in nature affects us so deeply; and yet we must be in some way beyond mutability to know mutability for what it is. The soul can be neither simply a thing eternal nor merely a creature of time; in its life the eternal and the temporal must somehow be combined in the closest interpenetration. No philosophical theory which treats the soul simply as one of the many 'existents' of nature and as sharing their 'passage' unequivocally can really do justice to Plato. For the development of the thought that in 'souls' the eternal and the temporal interpenetrate I would refer to Baron F. von Hügel's fascinating study, *Eternal Life*.

(2) A second point worth noting is that Timaeus is not absolutely consistent through the dialogue in his account of 'nature'. At p. 29 he is content simply to contrast the 'archtypes' (παραδείγματα) as eternal with their fleeting and temporal 'images' (εἰκόνες). In terms of the old Pythagorean antithesis this would mean that γένεσις : οὐσία :: ἄπειρον : πέρας. There would thus be only two terms in the analysis of nature as contrasted with three in the analysis of ψυχή. When we come to his actual corpuscular physics (48 c 2), he has to correct this as an inaccuracy by introducing a third term into the account of nature (τότε μὲν γὰρ δύο εἴδη διειλόμεθα, νῦν δὲ τρίτον ἄλλο γένος ἡμῖν δηλωτέον), the third term being the formless χώρα. This, as it seems to me, implies a shift in the meaning of γένεσις itself. It ceases to mean mere fluctuation and comes to mean definite and determinate process resulting in the establishment of a determinate result with a law of its own (γένεσις εἰς οὐσίαν.) That is, χώρα in the amended account, the formless 'receptacle' of determination, figures as the representative of the ἄπειρον. (It may seem strange that the possibility of geometry, a body of *aeternae veritates*, should depend on the 'formless' element in things. But the thought, no doubt, is that though χώρα contains the possibility of all geometrical figure and structure, it is itself 'structureless'. What we study in geometry is the structure of figures *in* space, figures which are rendered possible by the existence of the spatial continuum, not the structure of space itself, just as in arithmetic we study the properties of numbers or classes of numbers, and yet numbers themselves, according to Pythagoreanism, being assemblages of units, have in them an ἄπειρον, since 'the unit' is the most elementary combination of πέρας and ἄπειρον. Timaeus, thus, by correcting his original statement about nature at once finds room for geometry as well as arithmetic in the scheme of the sciences, and restores

the correspondence between the triplicity of nature and the triplicity of the ψυχή demanded by his adherence to the maxim that like can only be known by like.)

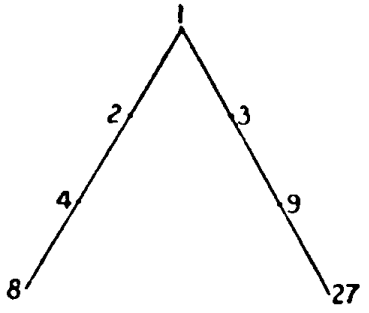
(3) I have abstained entirely from any attempt to find in what Timaeus says any traces of Plato's own theories about number as known to us from the polemics of Aristotle and the light derived from ancient commentators on these Aristotelian passages. My reason is simple but, I trust, sufficient. The reconstruction of Plato's deduction of the integer-series is necessarily speculative, but one thing is absolutely certain, that the element of the ἄπειρον or indeterminate factor in the deduction was played by the 'indeterminate dyad'. 1, 'the limit', was taken, as Aristotle tells us, as ultimate. The next step was to 'deduce' the number 2 by combining the 'unit' with the 'indeterminate dyad', or as Alexander of Aphrodisias tells us more precisely, 'the unit' by 'limiting' this dyad gave rise to 2; it is equally certain, from Aristotle's allusions, that the 'dyad' and its 'limitation' by the 'unit' was repeated more than once in the derivation of the rest of the numbers of the series 1, 2, 3 . . . 10. Nothing whatever is said in the *Timaeus* (or in any Platonic dialogue) about the 'indeterminate dyad'. The only δυάς of which we ever hear in the dialogues is the integer 2 itself. This seems to me convincing proof that all through his career Plato made no attempt to introduce into his dialogues the special and distinctive peculiarities of his personal doctrine about number. It would, indeed, not have been natural to do so. The dialogues, as their literary form proves, were evidently meant to circulate in the society of those who cared for the things of the mind at large, and probably to gain students for the Academy. Plato could fairly presume the audience for which he wrote to be well acquainted with the history of fifth-century science; he could not assume that it knew already everything that could be taught in the Academy.[1]

35 b 4–36 b 5. ἦρχετο δὲ διαιρεῖν . . . τρία καὶ τετταράκοντα καὶ διακόσια. The Demiurge now proceeds to divide up the stuff of the cosmic soul, into 'as many portions as were meet', each part being a perfect blend of the three constituents already named. The method of division is according to a mathematical formula which gives the intervals of a melodic progression. The cosmic soul itself is not, as it would be according to the formula of the Pythagoreans who are refuted in the *Phaedo*, an ἁρμονία of the corresponding body, but, being wise and good, it of course exhibits an ἁρμονία in its own structure, has music in itself. (It is this very conception of 'ghostly health' as an 'attunement' *in* the soul which is used at *Phaedo* 93 c ff. to show that the soul itself cannot *be* an 'attunement'.) Presumably we are to picture the division into 'portions' as made by stopping a vibrating string or strings with 'bridges' at different intervals so as to get notes of different pitch. First of all the Demiurge constructs a double set of lengths corresponding to the two

[1] We must remember Plato's poor opinion of written books as contrasted with living 'research'. The most striking expression of this feeling in his writings is at *Ep.* vii. 341 c 4 ff. Cf. the comments on these passages in Bt. *Greek Philosophy, Thales to Plato* pp. 220–3. Plato had already represented Socrates as holding similar views, *Phaedrus* 275 a–b.

numerical series 1, 2, 4, 8, and 1, 3, 9, 27, i.e. to geometrical progressions of the 'powers' of 2 and 3 from 2^0 and 3^0 to 2^3 and 3^3. The object of stopping with the *third* power in each case is a double one. (1) There are four terms in each series which thus form a pair of tetractyes or 'fours', the whole forming a 'double tetractys' with exactly 7 terms. Thus both the numbers 4 and 7, to which the Pythagoreans attached special importance, get recognition. This particular 'double tetractys' is the second of the eleven enumerated and described by Theo Smyrnaeus (ed. Hiller, p. 93–8), the series 1, 2, 3, 4, of which the sum is the 'decad' and which pretty certainly goes back to Pythagoras himself, being the first. So far as I am aware there is no evidence to show that our 'double' tetractys had been employed by any one before Plato introduced it into the *Timaeus*, but this is no proof that he invented it. It and its cosmic application *may* quite well belong to the Pythagoreanism of the latter part of the fifth century. (2) The two progressions represent the powers respectively of 2, the first even, and of 3, the first odd number. They both begin with 1 which was supposed, as the ἀρχή of number, to combine the character of odd and even in itself (because if you add 1 to an odd number you get an even number, if you add 1 to an even number you get an odd one). They stop with the third power, because the 'cube' or third power symbolizes the three dimensions of bodies. A third point is remarked by the ancients, that the numerically greatest of the terms of the double series, 27, is equal to the sum of its predecessors (27 = 1 + 2 + 3 + 4 + 8 + 9.) The musical significance of the numbers will occupy us immediately. (All this is carefully explained by Theon *op. cit.* 94–6.)

It is traditional to represent this double progression by a diagram in the form of a Lambda, thus:



and we learn from Plutarch that the figure is as old as Crantor, who used it in his commentaries on the *Timaeus*[1]. Since it was a disputed

[1] *Plut. de animae Procreatione* 1027 d περὶ δὲ τῆς τάξεως πότερον ἐφ' ἑνὸς στίχου πάντας ἐκθετέον ὡς Θεόδωρος ἢ μᾶλλον ὡς Κράντωρ ἐν τῷ Λ σχήματι κτλ. (The Theodorus meant is Theodorus of Soli mentioned also *op. cit.* 1022 d, apparently as a contemporary of Crantor.) The reason for arresting the progressions with the 'cubes' of 2 and 3 was rightly given by Adrastus, from whom it is repeated by Theon, 65. 1. It should be noted that whereas we speak of a line as having one dimension, a plane two, a 'solid' three, the Pythagoreans said that 2 symbolizes, or is, the line, 3 the plane, 4 the solid, because two non-identical points are needed to determine a straight line, three non-collinear points to determine a plane, four non-coplanar points to determine a 'pyramid'.

point as early as Crantor's time whether the numbers should not rather be 'exponed in one row' in their 'natural' order, we may infer that Plato himself did not insert the diagram in his dialogue, though it is quite possible that he knew and meant to allude to it. As for the name τετρακτύς, it means simply a 'four' (or a 'fourth' of anything), just as τριττύς (Ionic τρικτύς) means a 'three' or a 'third'. Any set of four things can be called a τετρακτύς, e.g. the four seasons, the four cardinal points, the four Empedoclean 'roots'. (These and others are all given as examples of 'fours' by Theon. So the 'quaternions' of Rowan Hamilton would be correctly denominated τετρακτύες in Greek). The most important of all these 'fours' is the original one, the series of integers 1, 2, 3, 4. The point is that the sum of the series is 10. Properly it should be written as a pattern of points, thus, so as to form an equilateral triangle. The diagram shows at a glance that the sum of the first four integers is 10, the radix of our own and most civilized 'scales of notation'. The Pythagoreans held that we count 'by tens', not for the obvious reason that we have ten fingers but because there is some deep mathematical and cosmical significance in the number 10 itself which makes it proper to regard all numbers above ten, 'the complete number', as mere repetitions (Arist. *Met.* A. 986ᵃ 8, ἐπειδὴ τέλειον ἡ δεκὰς εἶναι δοκεῖ καὶ πᾶσαν περιειληφέναι τὴν τῶν ἀριθμῶν φύσιν).[1]

35 C 2. μετὰ δὲ ταῦτα συνεπληροῦτο κτλ. The Demiurge, having fixed the seven fundamental terms of the series, 'went on to fill up' the διπλάσια καὶ τριπλάσια διαστήματα, 'the intervals of the double and triple', that is, the intervals in the two series of powers of 2 and powers of 3, by inserting between every two adjacent terms in either series two intermediates or 'means', an Harmonic (one which 'surpasses and is surpassed by the same part of the extremes'), and an Arithmetical ('one which surpasses and is surpassed by the numerically same amount.'). The Harmonic mean is mentioned first, because, if the series as thus enlarged are written in the natural ascending order, the H.M. will occur before the A.M. between any two terms (the H.M. will be nearer to the lesser 'extreme'). The two series now become

$$\begin{cases} 1, 4/3, 3/2, 2, 8/3, 3, 4, 16/3, 6, 8. \\ 1, 3/2, 2, 3, 9/2, 6, 9, 27/2, 18, 27. \end{cases}$$

For convenience' sake we may now write them as one series, arranging

[1] The δεκάς embraces 'the whole nature of number' since it contains the ἀρχὴ ἀριθμοῦ 1, the first *even* number 2, the first odd number 3, the first even 'square' 4, the first odd 'square' 9, the first 'cube' 8; it also contains numbers which are factorizable into odd and odd (9), into even and even (4, 8), into even and odd (6, 10), and primes which are not factorizable at all (1, 3, 5, 7). Thus there is no recognized kind of number which it does not include. Endless cosmological and physiological significations will be found, e. g. in the section of the *Theologumena Arithmetica* given to the δεκάς (ed. Ast, pp. 58–64). On the 'patterns' of numbers and their connexion with the study of the series which are still called 'figurate numbers' in our algebras, see Theo Smyrnaeus, *op. cit.* (ed. Hiller) pp. 31–42; Nicomachus Gerasenus, *Introductio Arithmetica* ii. 6–17 (ed. Hoche, pp. 82–112); Iamblichus, *in Nicomachi Introduct. Arith.* §§. 80–101 (ed. Pistelli, pp. 56–72); *EGPh.*³ 100–4. The account of Nicomachus is especially full and clear.

its terms in the natural ascending order (as Theodorus presumably did); this gives us

1, 4/3, 3/2, 2, 8/3, 3, 4, 9/2, 16/3, 6, 8, 9, 27/2, 18, 27.

The insertion of these 'links' (*τούτων τῶν δεσμῶν*, 36 a 7) makes intervals of 4/3, 3/2, 9/8, in the original series; i. e. in the enlarged series every term but the first has to its precursor one of the ratios, 4/3, 3/2, 9/8. These are the ratios which correspond to the melodic intervals of the major fourth, major fifth and major tone, so that we see that the Demiurge is aiming at the construction of a scale. We must bear in mind that the 'unit' of the Pythagorean scale is not the octave but the tetrachord (the compass of the major fourth). The octave is thought of as composed of two 'disjunct' tetrachords. The 'fifth' is the interval which the first note of one of the two tetrachords makes with the first note of the other; the tone was regularly defined as the 'excess' of a fifth over a fourth, i. e. the interval between the last note of the one tetrachord and the first note of the other. (This fixes the ratio corresponding to the tone, since $3/2 \div 4/3 = 9/8$). These three are the only regular 'intervals' recognized in the scale of Timaeus. This is as it should be. The determination of the first three was unanimously ascribed in antiquity to Pythagoras and that of the tone immediately follows. It would appear that down to the time of Plato and his friend Archytas in the fourth century, no attempt was made to subdivide the tetrachord scientifically.[1] (This means, in practice, that the individual musician would make the lesser intervals to please his own ear. The uncertainty of these internal intervals would probably be put down by a Pythagorean, as Bt. has said, to the irrational and intractable nature of the *ἄπειρον*.)

We can see already also what the compass of the scale Timaeus is contemplating must be. It must be represented by the ratio of the two extreme terms to one another, i. e. by 27/1, or 1/27. This will give us four octaves (16/1) *plus* a fifth *plus* a tone, since $\frac{16}{1} \times \frac{3}{2} \times \frac{9}{8} = \frac{27}{1}$. The

[1] See Ptolemy *Harmonica* i. 13 (*Fr. d. Vors.*[3] i. 327) where the classification of musical *γένη* into the *ἐναρμόνιον*, *χρωματικόν*, and *διατονικόν*, according to the way in which the tetrachord is subdivided, is specially attributed to Archytas ('A. . . . *μάλιστα τῶν Πυθαγορείων ἐπιμεληθεὶς μουσικῆς πειρᾶται μὲν τὸ κατὰ τὸν λόγον ἀκόλουθον διασῴζειν οὐκ ἐν ταῖς συμφωνίαις μόνον ἀλλὰ καὶ ταῖς τῶν τετραχόρδων διαιρέσεσιν . . . τρία μὲν τοίνυν οὗτος ὑφίστησι γένη . . .*). Cf. Theo Smyrnaeus (ed. Hiller p. 61) who is here reproducing Adrastus, as it appears. He has previously spoken of the original Pythagorean intervals of the octave, fourth, fifth, and defined the tone as 'the difference between fifth and fourth', and now proceeds *οἱ δὲ περὶ Εὔδοξον καὶ Ἀρχύταν τὸν λόγον τῶν συμφωνιῶν ἐν ἀριθμοῖς ᾤοντο εἶναι, ὁμολογοῦντες καὶ αὐτοὶ ἐν κινήσεσιν εἶναι τοὺς λόγους.* See also *Greek Philosophy Thales to Plato* 47–8 with the works there referred to. There is a well-known allusion to attempts to make lesser intervals 'by ear' put into the mouth of Glaucon at *Republic* 531 a 4 ff. *νὴ τοὺς θεούς, ἔφη, καὶ γελοίως γε, πυκνώματ' ἄττα ὀνομάζοντες καὶ παραβάλλοντες τὰ ὦτα, οἷον ἐκ γειτόνων φωνὴν θηρευόμενοι, οἱ μέν φασιν ἔτι κατακούειν ἐν μέσῳ τινὰ ἠχὴν καὶ σμικρότατον εἶναι τοῦτο διάστημα, ᾧ μετρητέον, οἱ δὲ ἀμφισβητοῦντες ὡς ὅμοιον ἤδη φθεγγομένων, ἀμφότεροι ὦτα τοῦ νοῦ προστησάμενοι.* As Adam remarks *in loc.* what Socrates has just said of the unsatisfactory state of 'harmonics' is meant as a criticism of the Pythagoreans, who have been mentioned at 530 d, though Glaucon supposes it to refer only to 'empirics'. Socrates' dissatisfaction with the Pythagoreans has much more point if, as is now maintained, they had in his time established no definite subdivision of the tetrachord.

compass of the whole will thus be four octaves and a major sixth. We in modern times are accustomed to state the 'harmonic' ratios as those of the numbers of vibrations per second corresponding to the notes sounded. Thus, on this plan, the 'higher' number answers to the 'higher' note. The Greeks, being unable to determine the precise frequencies of vibration of strings, use the method of comparing the lengths of strings which, when vibrating, give out the different notes. Hence, in their method, the 'higher number' corresponds to the note of 'lower' pitch, though this is concealed from a careless reader by the fact that, from the position in which the lyre was held, the string which gives out the note of acutest pitch is called *νήτη* 'bottommost' and that which gives out the note of deepest pitch *ὑπάτη* or 'uppermost'. When the 'octave' is said in Greek to have the ratio 2/1 to the ground-tone, the note meant is an octave *below*, not an octave *above*, the ground-tone. Hence, if it were permissible to write Plato's great progression in our modern notation, it would have to be written as a *descending* progression.

The compass of Plato's progression is much greater than any which was employed in contemporary music. Adrastus (cp. Theon, op. cit., p. 64) called attention to this, remarking that Aristoxenus treated of no *ἁρμονία* more extended than one of two octaves and a fourth, and that the 'moderns' knew of none which ranged over more than three octaves and a tone. But, as Adrastus added, Plato is not constructing a scale which can be sung by the human voice or heard by the human ear. It is an 'unheard melody' of which he is speaking and it would be absurd to expect it to be confined within the range of a human larynx.[1]

We have now got the compass of the progression and have its constituent tetrachords marked off for us, but we have still to know how the tetrachords themselves are subdivided. If it is true that before Plato's own time there was no definite division recognized, Timaeus is here going a little beyond the established doctrine of his age, though he can hardly be said to be illegitimately transgressing the limits of Pythagoreanism if precise formulae were first given by a fourth-century Pythagorean, Plato's friend and correspondent Archytas, the famous statesman and engineer of Tarentum.

36 b 1–5, τῷ τοῦ ἐπογδόου . . . τρία καὶ τετταράκοντα καὶ διακόσια. This explains how the tetrachords were subdivided. Whenever we find an interval of 4/3 we fill it up with intervals of 9/8, i.e. we insert in the tetrachord as many intervals of a major tone as are mathematically possible. As a simple example will show, we can insert two such intervals in a tetrachord, and no more. 3, 4 are numbers of which the higher has the *ἐπίτριτος λόγος* to the lower. Between them we can

[1] Adrastus ap. Theon. *op. cit.* 65 (ed. Hiller) *ῥητέον . . . ὡς ἐκεῖνοι μὲν πρὸς τὴν ἡμετέραν χρῆσιν ὁρῶντες οὕτως ἐποίουν, ἡγούμενοι μὴ πλεῖόν τι τούτων δύνασθαι μήτε τοὺς ἀγωνιζομένους φθέγγεσθαι μήτε τοὺς ἀκούοντας εὐγνώστως κρίνειν, Πλάτων δὲ πρὸς τὴν φύσιν ὁρῶν, ἐπειδὴ τὴν ψυχὴν ἀνάγκη συνισταμένην καθ' ἁρμονίαν μέχρι τῶν στερεῶν προάγειν ἀριθμῶν . . . ὅπως διὰ παντὸς ἐλθοῦσα τοῦ τελείου στερεοῦ κοσμικοῦ σώματος πάντων ἀντιληπτικὴ γενήσεται τῶν ὄντων, καὶ τὴν ἁρμονίαν αὐτῆς μέχρι τούτου προαγήοχε, τρόπον τινὰ καὶ κατὰ τὴν αὐτῆς φύσιν ἐπ' ἄπειρον δυναμένην προιέναι.*

insert $\frac{3}{1} \times \frac{9}{8} = \frac{27}{8}$ and also $\frac{3}{1} \times \frac{9}{8} \times \frac{9}{8} = \frac{243}{64}$, since both these fractions are > 3 and < 4. We could not insert another such interval, since $\frac{243}{64} \times \frac{9}{8} = \frac{2187}{512}$ is > 4. But as we also see, the two intervals of 9/8 do not completely 'fill up' the interval from 3 to 4, since $\frac{243}{64}$ is < 4. There is something 'left over', as Timaeus says, and as he adds the ratio answering to this 'gap' is that of 4/1 : 243/64 i. e. the ratio 256/243. The tetrachord will thus be divided into two intervals of 9/8, two 'major tones', and a further interval of 256/243, less than a whole tone, which got in the technical writers on music the name of λεῖμμα 'a remainder'. (The 'tone' cannot by any device be divided into two equal semitones. For suppose that it could, and that x/y was the ratio corresponding to the division. Then, since the whole tone answers to the ratio 9/8, you would have $9 : x/y :: x/y : 8$ or $72y^2 = x^2$, and there would be a rational integral solution of this equation; there would be two integers x and y such that $72y^2 = x^2$ or that $6\sqrt{2}y = x$. This is impossible for the reason that $\sqrt{2}$ is not a rational fraction, an awkward fact which the Pythagoreans of Timaeus's time had discovered, as we see from the tale that Hippasus was expelled from the society for revealing this very serious objection to the doctrine that all things are made of numbers to the world at large.)[1]

It is important to insist on the point on which Proclus rightly lays stress (Diehl, ii. 188) that there must be no intervals in the progression except those which Plato has specified, i. e. the intervals between one note and the next are always major tones except where, in completing the tetrachord, the λεῖμμα he has described occurs. In particular, we must not have any occurrence of the interval called ἀποτομή, which, conjoined with the λεῖμμα, completes the major tone. (Its 'ratio' therefore, will be $\frac{9}{8} \div \frac{256}{243} = \frac{2187}{2048}$.) If Plato had meant this interval to occur in his progression we may be sure that he would have mentioned it, as Proclus correctly says. Unfortunately, even in ancient times the error of introducing it had been already committed, and the same fault infects,

[1] For the tale of Hippasus see *Fr. d. Vors.*[3] i. 36-7. There is another version, according to which the secret let out was the inscription of the dodecahedron in the sphere. Now the first step to this construction is the cutting of a straight line in what Euclid calls 'extreme and mean ratio', i. e. the division of $a+b$ into two parts a and b such that $a+b : a :: a : b$, in other words the solution of the equation $b(a+b) = a^2$ or $b^2 + ab - a^2 = 0$. We can at once write down the solution of this equation as $b = \frac{-a \pm \sqrt{5a^2}}{2}$, i.e. $b = \frac{a(\pm\sqrt{5}-1)}{2}$. Both versions of the story thus point to the serious trouble caused to the Pythagoreans of the fifth century by the discovery that there are 'irrational' lengths, and thus that geometry cannot be regarded as a simple application of the arithmetic of integers. As Bt. has said, the discovery of the 'theorem of Pythagoras' (Euclid i. 47) itself would directly lead to the awkward discovery of the 'irrationality' of $\sqrt{2}$.

I believe, all the modern versions (apparently dependent on Boeckh,) of Plato's great series. The error is *at least* as old as the first century of our era, for the *Timaeus Locrus*, commenting on this passage, says that there are 36 terms in the series and that if we represent all the terms of the ratios by integers, the sum of the whole series is 114,695.[1] This implies that, to clear fractions, we multiply every term of the series by 384, so that we begin with 384 instead of 1, and end with $27 \times 384 = 10{,}368$, instead of 27. (The convenient use of 384 as a multiplier goes back to Crantor, and is thus a part of the earliest tradition).[2] But, as Proclus observes, an ἀποτομή has to occur twice in the progression if we are to retain the number given by 'Timaeus Locrus' as the sum of all the terms. As it seems to me so evident that Proclus is right in refusing to make the text of Plato square with the *Timaeus Locrus* by intercalating intervals of which Plato has said nothing, I feel bound to hold that all modern editors who keep 114,695, as the sum of the terms are doing plain violence to their author. Against all of them I would simply set the sensible words of Proclus (Diehl, ii. 188), 'Plato never mentioned the ἀποτομή, and I have therefore confined myself to the λεῖμμα and been content with the terms already exhibited. Indeed, how could he have used the ἀποτομή, since he has adopted the diatonic *genus*, in which the tone is not divided, whereas the ἀποτομή arises from division of the tone, being what is left of the tone after the λεῖμμα'? There is a further difficulty about the number of the terms in the series; according to *Timaeus Locrus* and the interpretations based on that document, it is 36, a number to which, as the square of the first 'perfect number 6',[3] the Pythagoreans ascribed many virtues. But it is quite impossible to construct an ἁρμονία with a compass

[1] *Timaeus Locrus* 96 b δεῖ δ' εἶμέν πως πάντας σὺν τοῖς συμπληρώμασι καὶ τοῖς ἐπογδόοις ὅρους ἓξ καὶ τριάκοντα, τὸν δὲ σύμπαντα ἀριθμὸν γενέσθαι μυριάδας ἕνδεκα καὶ τετττόρων χιλιάδων ἑξακοσίων $\overline{\varrho\epsilon}$. For Boeckh's version of the ἁρμονία see the essay 'Über die Bildung der Weltseele', *Kl. Schriften* iii. 161, and for his defence of the view that there are 36 terms of the series, the long note *ib.* p. 162–3. He argues that *Timaeus Locrus* being so much earlier than Proclus deserves more credit, a contention which does not impress me. The desire to get in the wonderful number 36 would be a potent source of misinterpretation.

[2] Plutarch *de animae Procreatione* 1020 c ὁ μὲν οὖν Εὔδωρος ἑπακολουθήσας Κράντορι πρῶτον ἔλαβε τὸν $\overline{\tau\pi\delta}$. Plutarch himself preferred to use as common multiplier half this number, 192. This he does for the reason that by taking 192 for multiplier you get for the first tetrachord 192, 216, 243, 256, so that the numbers by which Plato defines the λεῖμμα appear as actual terms of the series, whereas, on Crantor's method, you get their doubles, 486, 512. But it is no more necessary that the actual numbers of the ratio 256/243 should figure in the series than that it should contain the actual numbers 3, 4 because the ἐπίτριτος λόγος occurs.

[3] 6 is a 'perfect' number in the sense in which the word is still used in arithmetical theory, i.e. it is the sum of its own divisors ($1 + 2 + 3 = 6$). The Pythagoreans were impressed by this, and accordingly discovered many cosmological and physiological significances of the number. The curious may find the richest collection of these in the section of the *Theologumena Arithmetica* which deals with the ἑξάς. The number 36, the product of a 'perfect' number by itself was further arithmetically interesting because it is the *product* of the first three 'squares' ($36 = 1 \times 2^2 \times 3^2$), and also the *sum* of the first three 'cubes' ($36 = 1^3 + 2^3 + 3^3$). A host of physiological and other significances were accordingly discovered for it which do not concern us here. They may be looked for in the section of the *Theolog. Arith.* already indicated, in Plutarch *de animae Procreat.* 1027 f, and elsewhere.

of four octaves and a sixth in the way Plato directs, so as to get thirty-six terms. Proclus therefore held that Plato's series is meant to have only thirty-four terms, and I cannot help believing that he was right. It seems to me that the whole trouble in the passage has been created, certainly as early as the first century A.D., possibly earlier, by a desire to make Timaeus take account of fancies about the number 36 which are not really in his mind. Because some Pythagoreans indulged these fancies, it was assumed that Timaeus must be embodying them in his progression, and then, to get the requisite number of terms, two had to be intercalated which introduce an interval he is manifestly ignoring. Proclus showed his usual sturdy sense, in refusing to have anything to do with this wanton *Pragmatismus*. He has given us his own version both of the sum of the whole series and of its individual terms. Unfortunately, if one adds up the separate items in his list, the result does not agree with his own statement of the total, and his latest editor, Diehl, has conjecturally to insert some numbers, and bracket others. I cannot fully go into the question of the text of Proclus here, but I believe the series he intended to give as the true one can be reconstructed by starting from 384, ending up with 10,368 (384 × 27), and filling in the intervals by Plato's express directions. The discrepancies between his own (correct) sum for his total series and the enumeration of the separate terms seems to me to have arisen from an attempt, which can be traced in the *apparatus criticus* of Diehl, to make his statement correspond with those which would be got by introducing an ἀποτομή twice, in the fashion presupposed by the *Timaeus Locrus*, and the MSS. to be therefore suspicious in their testimony to what Proclus wrote. If we start with 384 as our first term and construct a series out of the multiples of that number which correspond to the first three powers of two and three, we get (arranging the series in ascending order) 384, 768, 1,152, 1,536, 3,072, 3,456, 10,368. We now have to 'fill up' the 'intervals of 4 : 3' by 'intervals of 9 : 8' in such a way that the only ratio of any term to its immediate precursor other than 9/8 is to be the λεῖμμα, 256/243. *Where* the λεῖμμα is to be brought in is indicated by the fact that we are dealing with a musical scale and that, as appears from the silence about all intervals less than the λεῖμμα, the scale is 'diatonic'. That is, its tetrachord is made up, in the descending order, of the intervals tone, tone, λεῖμμα; the octave is constructed of two such tetrachords which are 'disjunct', i.e. there is an interval of a tone between the last note of one of them and the first of the next. This gives us as the octave the sequence tone, tone, λεῖμμα, tone, tone, tone, λεῖμμα. The 'sixth' which remains after four octaves have been completed, we shall naturally regard as made by a tetrachord followed by two intervals of a tone. This would give us the series 384, 432, 486, ϡλ 512, 576, 648, 729, ϡλ 768, 864, 972, ϡλ 1,024, 1,152, 1,296, 1,458, ϡλ 1,536, 1,728, 1,944, ϡλ 2,048, 2,304, 2,592, 2,916, ϡλ 3,072, 3,456, 3,888, ϡλ 4,096, 4,608, 5,184, 5,832, ϡλ 6,144, 6,912, 7,776, ϡλ 8,192, 9,216, 10,368. I submit, therefore, that this is probably the series intended by Timaeus. There are, however, two points about which I feel some uncertainty. Proclus (Diehl, ii. 236) give a statement of his own about the sum of the thirty-four terms. He says that the total is

105,947.[1] (The ἐννέα here is supplied to fill up a lacuna by C. E. G. Schneider, but there can be no doubt that the figure is right, for a reason to be mentioned immediately). This total cannot be reconciled with the list of the several terms given in any of the MSS. of Proclus, and it is not the sum of the series as I have tried to construct it. The sum of my series is 105,113, less by 834 than the total given by Proclus. If, however, we replace the terms 4,096 and 8,192 in my series by 4,374 and 8,748 respectively (both are mentioned in the MSS. of Proclus), we get the exact total of Proclus. Hence it is, I think, certain that, with these two points of difference, Proclus' series coincided with my own and we know what the terms of it were, in spite of variants in the MSS. probably due to the influence of the *Timaeus Locrus*. Now it would be *possible* at both these points in the series to take the terms given by Proclus as those meant by Plato. The term immediately before 4,096 in the series as I have given it is 3,888, the term immediately after is 4,608. If we take 4,096 as the intermediate term we get the sequence 3,888, 4,096, 4,608, which corresponds to an interval of a λεῖμμα followed by a tone; if, with Proclus, we make the sequence 3,888, 4,374, 4,608, we get tone followed by λεῖμμα. Exactly the same thing happens in the second place of doubt. Where the sequence 7,776, 8,192, 9,216, gives the order 'tone, λεῖμμα', the sequence clearly adopted by Proclus, 7,776, 8,748, 9,216, gives 'λεῖμμα, tone'. Thus, the series as it was constructed by Proclus conforms no less than the slightly different series I have proposed to the fundamental conditions that it is composed only of intervals of 9/8 and 256/243. But with Proclus' series, we twice over have a tone followed by a λεῖμμα where we expect in a 'diatonic' scale a λεῖμμα followed by a tone. I do not feel competent to say that this is certainly wrong, but I believe it unlikely to be right, and I think I can explain how an error might be made just at these two points. Plato does not expressly *say* anywhere that successions of three tones and a λεῖμμα are always to be separated by a succession of two tones and a λεῖμμα. I have assumed that this is to be the case because it must be so in constructing the octaves of a 'diatonic' scale. I presume Timaeus to take it for granted that his hearers will 'supply' this condition. But, as far as the words go, they might mean—if we choose to regard the series as simply one of numbers, and neglect its musical character—that we are to have three 'intervals of 9/8' wherever they are arithmetically possible. Now it *is* possible to have three of them after the term 3,072, since $3{,}072 \times 9/8 = 3{,}456$, $3{,}456 \times 9/8 = 3{,}888$, $3{,}888 \times 9/8 = 4{,}374$. If we make this last a term of the series, the next term, 4,608 gives us a λεῖμμα (since

$$4374 \times \frac{256}{243} = 4608.$$

The same possibility recurs with the ante-penultimate term (since

$$7776 \times 9/8 = 8748, \quad \text{and} \quad 7776 \times \frac{256}{243} = 8192).$$

In both places Proclus has assumed that 'intervals of 9/8' are to be intercalated so long as it is arithmetically possible, i.e. until you get a

[1] μυριάδες δέκα χιλιάδες πέντε ἑκατοντάδες (ἐννέα δεκάδες) τέσσαρες μονάδες ἑπτά.

term which is no longer divisible by 8. This is what the language of Timaeus, taken wholly by itself, would suggest, and I do not therefore feel sure that Proclus may not have been entirely right about every term of the series. But the probability that Timaeus is tacitly assuming that the sequence of intervals in the two tetrachords which make up a 'diatonic' διὰ πασῶν will be before the minds of his auditors seems to me so strong, that, on the whole, I believe I am right in differing from him about two terms, the twenty-fifth and the thirty-second of the series. I am, at any rate, sure that the series intended by Timaeus is either that of Proclus or mine, since those of Boeckh and his followers (Stallbaum, Apelt), introduce an interval other than the λεῖμμα. This is done by inserting the two terms 2,187 and 6,561. Apparently the only justification for the procedure is the assumption that the *Timaeus Locrus* must be right in its statements.[1] My own belief is that the attempt to make the number of terms 36 is unwarranted. Plutarch (*de animae Procreatione* 1027 f.) has some remarks about the peculiarities of this number, which he calls ἡ ὑπὸ τῶν Πυθαγορικῶν ὑμνουμένη τετρακτύς. It is not one of the eleven 'quaternions' enumerated by Theon, and Plutarch's observations may suggest a doubt whether it was really called a τετρακτύς of the Pythagoreans at all. He says that its special virtue is that it is the sum of the first four odd and the first four even numbers. I.e. $36 = (1+3+5+7)+(2+4+6+8)$. This might prove 36 to be the sum of two 'fours', but it certainly does not entitle it to be called a 'four' itself, and Plutarch only makes out its title to the appellation by going on to split it up into the components $(1+2)+(3+4)+(5+6)+(7+8)$, a method by which almost any number might be tortured into the form of a 'four'. He also refers to the more commonly mentioned properties of the number, that it is the product of the first three 'squares' and also the sum of the first three 'cubes'.[2] In Plutarch these remarks are only introduced to show that the 'double tetractys' with which Timaeus operates is still more remarkable for its arithmetical properties than 36 is. He says nothing about the number of terms in Timaeus's progression. Chalcidius also is silent on this point and says nothing about the ἀποτομή. Hence it is presumable that neither he nor Plutarch supposed it to figure in the construction of the scale.[3]

Plato's scale does not correspond to any in modern use, and would probably be displeasing to our ear. This is why it is misleading to write it in our notation. The main reason for the difference is that Plato assumes the διὰ τεττάρων (the interval of the major fourth) to be divided into two

[1] *Arithmetically* the insertion is possible since 2187/2048 is the ratio corresponding to the ἀποτομή and 6561/6144 = 2187/2048. The ἀποτομή is not an interval of the diatonic scale. (Cf. Gaudentius *Isagoge* 14, Jan *Scriptores Musici* 343.)

[2] Plut. *op. cit.* 1018 b-c, where many other curious numerical properties of 36 are specified.

[3] See Chalcidius *Comment* §§ 47–50. Chalcidius, like Plutarch, uses 192 (not the 384 of Crantor) as the first term of the series. It is worth noting that if the fragments of 'Philolaus' are to be trusted Ph. knew nothing of the 'apotome'. For it is expressly said in Fr. 6 (*Fr. d. Vors.*[3] i. 311–12) that the ἁρμονία or octave has a compass of five tones and two *dieses*, and this is exactly right if we take the δίεσις to be what Timaeus calls the λεῖμμα, and not otherwise.

equal tones and the λεῖμμα. But in modern music the two tones of an (ascending) fourth, accurately produced, are not equal. The first is a *major* tone (having the ratio 9/8, like Plato's tone), the second is a *minor* tone with the ratio 10/9). Thus the two together make an interval of $\frac{9}{8}\times\frac{10}{9}=\frac{5}{4}$. This is the very important interval of the major third, and its absence from early Greek music is the most striking of all the differences between the Greek scale and our own.[1] It follows also that the interval which completes the tetrachord in our modern major scale, the so-called semitone is different from the λεῖμμα. The value is not $\frac{256}{243}$ but $\frac{4}{3}\div\frac{5}{4}$, i.e. $\frac{16}{15}=\frac{256}{240}$. The reason for making the two two 'tones' of the modern major scale unequal is precisely that together they may make up an exact interval of a 'third'. The consequence of this is that no Greek of the time of Socrates or Plato could have sung an ordinary modern tune in a 'major' key. He would have thought the intervals of our melodies unnatural and 'out of tune', and we should think the same about his tunes. If we are to imagine Plato's scale with any success, we must think of it as made by an ideally accurate voice or on an instrument like the violin, where the performer makes his intervals for himself. The general effect would be, to our ear, more like that of our 'minor' scales than that of our 'major', because the 'tones' in the tetrachord were equal, as they are in our minor, not unequal, as in our major. But they were 'major' not 'minor' tones. Hence the λεῖμμα left over to complete the 'fourth' is different from both our 'major' and our 'minor' semitone. The division of the fourth into two major tones and a λεῖμμα is characteristic of the so-called 'severe diatonic' (διατονιαῖον σύντονον) of Greek music, which was felt to be classical and restrained by contrast with the other two principal scales, the 'chromatic' and 'enharmonic', in which the intervals within the fourth were more violently unequal. (For all further information on the construction of Greek ἁρμονίαι I must be content to refer to the articles s. v. *Musica* in the dictionaries of classical antiquities or to special treatises. The whole subject is beset with still unsolved problems on which I have no right to a personal opinion.) If down to the time of Archytas and Plato there was no fixed division of the tetrachord, the later precise rules for the construction of the 'severe diatonic' will be a crystallization of the 'classical' taste of persons like Timaeus. Any remarks about the cosmological significance of the numbers of Plato's series may be conveniently deferred until we come to comment on 36 d.

36 b 5–c 4. καὶ δὴ καὶ τὸ μειχθὲν . . . τῶν κύκλων. We have apparently to think of the Demiurge as constructing a sort of thread like a tense wire, with distances marked off on it corresponding to the numbers from 1 to 27

[1] It should be added that the writers on music regularly state that in the *ascending* diatonic tetrachord the order of the intervals is λεῖμμα, tone, tone (i.e. they contemplate such a progression, approximately, as E F G A or B C D E). Timaeus instructs us to insert the intervals of 9/8 first, so that the λείμματα only occur where we cannot insert any more such intervals. This means that his musical progression is a descending one.

which make up the two progressions of 2 and 3. (They would thus form one long monochord. By stopping this by a 'bridge' just at one of the junctures you would get a note of the progression Timaeus has described.) Next the Demiurge splits the band thus constructed longitudinally down its middle (*κατὰ μῆκος* 'in the direction of its length'). Then he makes the two halves intersect at their middle points, like a great uncial + with equal arms (*μέσην πρὸς μέσην . . . προσβαλών*), then he bends the two arms of the cross so formed into two circles, so that the ends of each meet (*κατέκαμψεν εἰς ἓν κύκλῳ*). We now have two circles in different planes but with a common centre, touching each other at two diametrically opposite points, thus . We shall hear later on that the Demiurge finally tilted the 'inner' circle (*πλαγίαν οὖσαν* 39 a 1), so as to incline its plane obliquely to that of the other. This is because, in the end, the two circles are to represent astronomically the *sidereal* equator (a section of the spherical *οὐρανός* by the plane of the *earth's* equator), and the ecliptic (the trace made by the sun's annual journey through the zodiac), and[1] the ecliptic makes an acute angle with the equator. We are probably not to suppose that the comparison of the figure made by the first crossing of the two bands to a Chi contains any reference to this inclination of the ecliptic. The first allusion to this is given at c 7 below in the words *κατὰ διάμετρον*. In the fifth century the arms of the letter appear to have been commonly drawn at right angles to one another. We should rather think of the tilting as done *after* the strips have been bent round into circles.

36 c. 1–2. *ἐν τῷ καταντικρὺ τῆς προσβολῆς*, i. e. the strips, now made into circles, are made to meet a second time at a point diametrically opposite to that where they originally crossed one another, (their original *προσβολή*).

36 c 2–4. *καὶ τῇ κατὰ ταὐτὰ . . . κύκλων*, i. e. he made each circle revolve. As yet nothing is said of the difference of *sense* of the revolutions of the two circles. We must not say that the phrase *ἡ κατὰ ταὐτὰ ἐν ταὐτῷ περιαγομένη κίνησις* means revolution of a sphere on its axis. We are not dealing with spheres, but with circles, and the motion meant is the revolution of a cart-wheel. Timaeus is, in fact, starting from the same general conception which underlies Anaximander's description of the three wheels of the sun, moon, and 'stars', for which see Hippolytus *Refutat. Haereseum*, i. 6 (*Doxogr. Gr.* 559, 22 ff.) = R. P. 20, and *EGPh.*[3] 68–70. So it is always of 'circles' that we hear is the myth of Er and the fragments of the second part of the poem of Parmenides. At bottom the theory originates with the conception of the earth as a disc, though Anaximander himself already supposed the disc to be the 'top' of a cylinder and the Pythagoreans had already got as far as recognizing the earth's sphericity. Note that the theory really implies that the

[1] Proclus thought that the inclination of the ecliptic *was* indicated by the words *οἷον χεῖ*, ii. 238 (Diehl), *διὸ καὶ τὰς εὐθείας οὐχ ᾠόμεθα δεῖν πρὸς ὀρθὰς λαμβάνειν, ἀλλ' οἱονεὶ χί, καθάπερ ὁ Πλάτων φησίν, . . . οὐδὲ γὰρ ὁ ἰσημερινὸς* (the equator) *πρὸς ὀρθὰς τέμνει τὸν ζωδιακόν*. This only shows that in the fifth century A. D. the arms of the letter Chi were regularly oblique to one another.

terrestrial 'disc' itself is revolving; we shall see later on that this actually was the view of Anaximander.[1]

We observe that much which sounds puzzling in early Greek astronomical language is explained if we bear in mind that whereas we habitually think of a planet or star as describing a circular path round a centre, the Greeks had a tendency to think of what we call the planet's or star's *track* as revolving and carrying round the heavenly body with it, as a ring turned round the finger carries round the stone set in it. All through Timaeus's account he speaks of what we call the 'orbit' of a heavenly body as being that which revolves and of what we call the revolving body as being at rest relatively to this orbit, just as the stone set in the ring is at rest relatively to the ring, and for that very reason is carried round as the ring is turned round the finger. It is from the same point of view that Socrates speaks in the *Republic* (vii. 529 d) of studying the 'real velocities' and paths of the heavenly motions 'with which they move and carry their contents' (ἃς τὸ ὂν τάχος καὶ ἡ οὖσα βραδυτὴς ἐν τῷ ἀληθινῷ ἀριθμῷ καὶ πᾶσι τοῖς ἀληθέσι σχήμασι φοράς τε πρὸς ἄλληλα φέρεται καὶ τὰ ἐνόντα φέρει); the 'contents' are the planets and stars themselves (*Greek Philosophy, Thales to Plato*, p. 227.) This way of speaking explains also why Aristotle argues from the fact that the moon always turns the same face to the earth that the moon can have no axial rotation of its own.[2] As Bt. says (*EGPh.*[2] 297 n. 1), to us this *proves* that the moon completes an axial rotation in (approximately) the same time that it completes a revolution round the earth. But what Aristotle has in his mind is the idea of the moon as carried round by its orbit, like a stone set in a ring, and he correctly infers that since we always see the familiar 'face' in the moon, the moon has no rotation *relative to its orbit*. It is the same analogy which leads him to maintain that no heavenly body has a true 'proper' motion; all are 'carried round' by a system of invisible 'spheres' (τὰ δὲ ἄστρα ἠρεμεῖν καὶ ἐνδεδεμένα τοῖς κύκλοις φέρεσθαι, *De Coelo* B. 289[b] 32). The hold the analogy had over Greek science is well illustrated by the great length and vehemence with which Proclus finds it necessary to urge his perfectly correct point that Timaeus does really mean to ascribe 'proper' motions to both stars and planets, and does not seriously think that they φέρεται ἐνδεδεμένα τοῖς κύκλοις.

36 c 3–4. καὶ τὸν μὲν ... τῶν κύκλων. The 'outside' circle is that of the sidereal equator, the 'inner' is the ecliptic. Of course, though one is said to be 'inside' the other, we are to think of them as of equal radius. Both have the same diameter, that of the κόσμος, since they are strictly geometrical circles, 'touching' at points. We may figure them as they appear e. g. on the surface of a 'celestial globe'.

36 c 4–5. τὴν μὲν οὖν ἔξω φορὰν ... τῆς θατέρου. The equator is the circle of the 'Same', the ecliptic of the 'Other' or 'Different' because

[1] Dante repeatedly calls the orbits 'ruote', wheels. E g. *Paradiso* i. 64, Beatrice tutta nell' eterne *rote* | Fissa con gli occhi stava; ib. i. 76 (of the whole system collectively) la *rota* che tu sempiterni | Desiderato, a sè mi fece atteso.

[2] *De Coelo* B. 290[a] 24 ἀλλὰ μὴν ὅτι οὐδὲ κυλίεται (roll) τὰ ἄστρα φανερόν· τὸ μὲν γὰρ κυλιόμενον στρέφεσθαι ἀνάγκη, τῆς δὲ σελήνης ἀεὶ δῆλόν ἐστι τὸ καλούμενον πρόσωπον.

it is the revolution of the equatorial circle which is to account for the diurnal revolution of the 'fixed' stars, and this appears to be regular and uniform. The annual path of the sun, to say nothing of those of its satellite planets, through the ecliptic, exhibits notable irregularity, and it is the great problem of a planetary theory to get rid of this appearance of lawlessness by explaining the apparent planetary paths as resultants of several regular uniform motions. We shall hear more of these irregularities as we proceed, but the most obvious of them may be mentioned at once, as it is presumably already in the mind of Timaeus at this point. Though it is not quite true that the 'sidereal day', the period from one transit of a given star over the meridian to the next, is absolutely constant, it is very nearly so, and the departure from constancy is far too minute to have been detected by any ancient astronomer.[1] This is why the equator is called the 'circle of the Same'. On the other hand, to say nothing of minor irregularities, there is an *ἀνωμαλία* of the sun, well-known to the ancients, of a very marked amount. The sun notoriously does not divide the year into four equal 'seasons'. The intervals from equinox to solstice are markedly unequal. It was this inequality which was originally called the solar 'anomaly', and, as we shall see, it was one of the 'irregularities' the early Academy was most anxious to account for. Probably it is with special reference to it that the ecliptic is called the 'circle of the Other' by Timaeus.[2]

36 c 5–7 τὴν μὲν δὴ ταὐτοῦ . . . ἐπ' ἀριστερά.

(1) *κατὰ πλευράν, κατὰ διάμετρον.* The words *πλευρά* and *διάμετρος* mean primarily the side and diagonal of a square or rectangle respectively (the *διάμετρος* still commonly means *diagonal* in Aristotle). All that is meant here is that the plane of the ecliptic is inclined obliquely to that of the equator as the diagonal of a rectangle is to its side. It is not said what the angle of inclination is, and we need not suppose Timaeus to know. The discovery of the obliquity (*λοξότης*) of the ecliptic was one of the first made by the Greek astronomers. According to Theophrastus

[1] The sidereal day is lengthened by the various causes which diminish the velocity of the earth's axial rotation (tidal friction, shrinkage due to cooling, &c.). These are partially compensated by other factors which tend in the opposite direction (e.g. the uplifting of a huge mass of mountains like the Himalayas in comparatively recent times). At present the total result is estimated to be a lengthening of the sidereal day by 1/200 seconds per century. (See A. R. Hinks *Astronomy* in the Home University Library pp. 132–6).

[2] The explanation of the 'anomaly', as I understand from my friend Mr. J. K. Fotheringham, is ultimately to be found in the perturbing influence of the great planets (particularly Jupiter) on the orbit of the earth. As the process is rhythmical and has a period, the amount of the anomaly is not always the same. Theon of Smyrna, and Chalcidius, who is here dependent on him, give the following statement, apparently taken by Theon from Adrastus, and presumably due in the last resort to Eratosthenes (Theon ed. Hiller, p. 153, Chalcidius *Comment.* § 78):

Spring (from vernal equinox to summer solstice) 94½ days;
Summer (from summer solstice to autumn equinox) 92½ days;
Autumn (from autumn equinox to winter solstice) 88¼ days;
Winter (from winter solstice to vernal equinox) 90¼ days.

From actual records of the exact times of the equinoxes and solstices in the year 1920 I find that in that year spring lasted for 92 days 19 hrs. 41 mins.; summer 95 days 26 hrs. 49 mins.; autumn 90 days 6 hours 48 min. Thus summer is now the longest season, winter the shortest.

it was due to Anaximander[1]; it was certainly known to his successor Anaximenes. The determination of the amount of the obliquity can hardly have been possible before the Greeks were acquainted with the division of the circle into degrees on which angular measurement depends. There seem to be no traces of this division of the circle in Greek literature before Alexandrian times. Presumably it came from Babylon when the conquests of Alexander had made the Babylonian records of observations accessible to the scientific men of the West. (No actual rectangle could have the radii of the circles of the Same and the Other as its side and diagonal, since the radii of the two circles are equal, whereas (Euclid, i. 47) the diagonal of a rectangle is always greater than any side of the figure. Yet Proclus forgets this in his anxiety to get in the 'irrationality' of the diagonal, and Boeckh gravely follows him! (*Kosmisch. System des Platon*, 28).

(2) ἐπὶ δεξιά . . . ἐπ' ἀριστερά. The daily (apparent) movement of the heavens from E. to W. is called 'towards the right hand', the yearly (apparent) movement of the Sun through the Zodiac from W. to E. is called 'towards the left hand'. The names are purely conventional, since Timaeus has told us that the οὐρανός has no hands at all. The choice of these implies that, if you are observing from any place in the northern hemisphere, you make your observation facing S., as a man watching the daily path of the sun naturally would in order to keep the object in view. You see the sun rise in the E. at your left hand, pass at noon straight before you and vanish in the evening in the W. at your right. This explains at once why the diurnal movement should be called 'right-handed' and the annual 'left-handed' From Aristotle[2] we learn that the Pythagoreans habitually described movement from E. to W. as ἐπὶ δεξιά, and Timaeus is thus using the language of the school to which he belongs. Since they also classed τὸ δεξιόν among the better and τὸ ἀριστερόν among the worse in their famous table of 'opposites',[3] this nomenclature has the advantage, from their point of view, that it makes the greatest and most uniform of all the astronomical movements, a movement 'towards the better part'. Aristotle takes the fancy so seriously that he gravely urges that since to a man looking to our visible pole the northern, movement from E. to W. appears to be 'to the left', the N. pole of the heavens must really be 'down' and the S. pole the true 'up',

[1] Pliny *H. N.* ii. 31 obliquitatem eius intellexisse . . . Anaximander Milesius traditur primus Olymp. LVIII (548–545 B.C.); cf. Aetius *Placit.* ii. 25. 1 (*Doxogr. Gr.* 355). The source of these statements is Theophrastus, who is not likely to have been misinformed on such a point. Apollodorus fixed the *date* of Anaximander by stating that he was sixty-four in the second year of this same Olympiad. As this is the year of the fall of Sardis, Bt. is likely to be right in holding that Anaximander himself had mentioned his own age at the date of that event. It is not safe to assume that Pliny had anything more definite to go upon in ascribing his astronomical discovery to the same Olympiad. That Anaximenes was aware of the obliquity may be inferred from his theory of the 'elevation' of the North Polar regions by which he explained the invisibility of the sun at night (or in the winter!), Aristot. *Meteor.* B. 354[a] 28, Aetius *Placit.* ii. 16. 6 (*Doxogr. Gr.* 346, R. P. 28 c).

[2] *De Coelo* B. 285[b] 25.

[3] Aristot. *Met.* A. 986[a] 24.

so that to ourselves the *κόσμος* appears to be 'standing on its head'.[1] Plato more rationally makes Timaeus explain in a later passage that there is no real 'up' or 'down' in Nature. What we call 'up' means simply the direction from the centre outwards, which, of course, varies at every point. It is clear that Plato is here purposely making Timaeus speak as a Pythagorean would, for he himself adopts the opposite convention. In the *Laws* (vi 760 d 2) it is laid down that *ἐπὶ δεξιά* 'towards the right' is to mean 'towards the sunrise', i. e. towards the E. (*τὸ δ' ἐπὶ δεξιὰ γιγνέσθω τὸ πρὸς ἕω*). Strictly in accord with this, but in flat contradiction of Timaeus, we are told in the *Epinomis* (987 b 5 ff.) that the planets move *ἐπὶ δεξιὰ μετὰ σελήνης τε καὶ ἡλίου*, whereas the 'eighth circle, which has the best right to the name *κόσμος* (*ὃν μάλιστά τις ἂν κόσμον προσαγορεύοι*), revolves in the opposite sense (*ἐναντίος ἐκείνοις σύμπασιν πορεύεται*). Proclus was very much disturbed by this divergence from the Pythagorean and Aristotelian doctrine and actually, as we learn from a later Neo-Platonist, probably Olympiodorus, used the contradiction as an argument against the genuineness of the *Epinomis*.[2] But the argument, if it proves anything, proves too much. The *Epinomis* naturally conforms to the *Laws* in its use of the words *ἐπὶ δεξιά, ἐπ' ἀριστερά*; to be consistent, Proclus should have anticipated the athetizers of the *Laws*. Since Plato held, as the *Timaeus* itself is enough to prove, that these anthropomorphic phrases, when applied to the *οὐρανός*, are purely conventional, he was entitled to adopt any sense for them he pleased. There was no reason why he should make the Academic speaker in the *Laws* talk like a Pythagorean; Timaeus does, but then *he is* a Pythagorean. Once more note that nothing is said about 'spheres'; we hear only of circular orbits. The famous 'spheres' were *introduced* into Greek astronomy by Plato's contemporary and associate Eudoxus of Cnidus; we never hear of them before Eudoxus, and, I may add, they

[1] *De Coelo* B. 285[b] 19 ff. *εἰ οὖν ἄρχεταί τε ἀπὸ τῶν δεξιῶν καὶ ἐπὶ τὰ δεξιὰ περιφέρεται, ἀνάγκη τὸ ἄνω εἶναι τὸν ἀφανῆ πόλον κτλ.* Aristotle agrees with the Pythagoreans that the movement is *ἐπὶ δεξιά*, but complains that they do not draw this necessary inference. On the difficulties in which Aristotle involves himself by taking the distinction between a cosmic 'right' and 'left' seriously, see Boeckh *Kosmisches System* pp. 103–22, and Sir T. L. Heath *Aristarchus of Samos* pp. 231–2.

[2] See the *prolegomena philosophiae Platonicae* § 25 (C. F. Hermann's text of Plato, vol. vi. p. 218), where Proclus's argument is given, *ἐν μὲν τοῖς ἄλλοις διαλόγοις αὐτοῦ φησὶ τοὺς πλανωμένους ἀστέρας ἀπὸ τῶν δεξιῶν ἐπὶ τὰ ἀριστερὰ κινεῖσθαι, ἐν αὐτῷ δὲ* (sc. *τῷ Ἐπινομίῳ*) *ἀπὸ τῶν ἀριστερῶν ἐπὶ τὰ δεξιά*. The other argument adduced by Proclus is equally idle—viz. that if Plato had lived he would have given a final revision to the text of the *Laws* and not have written a 'supplement'. We do not know that Plato may not have intended the *Epinomis* as a substantial part of the *Laws*, in fact as *Laws* xiii. What is really significant is that Proclus seems to have known of no one before himself who questioned the authenticity of the *Epinomis*, and to have appealed to no tradition in support of his view. This would suggest that the well-known words of Diogenes Laertius in the *Life* of Plato about Philippus of Opus, who is said to have transcribed the *Laws* for circulation *οὗ καὶ τὴν Ἐπινομίδα φασὶν εἶναι*, do not really mean, as they have been thought to do, that there was a tradition that Philippus composed the *Epinomis*. The meaning will rather be that he transcribed it, as he did the *Laws*. It is worth noting that some later writers actually regard the *Epinomis* as the thirteenth book of the *Laws*. E.g. Nicomachus of Gerasa (*Introductio* iii. 5, ed. Hoche p. 6) introduces a quotation from *Epin.* 991 e with the reference *Πλάτων ἐπὶ τέλει τοῦ τρισκαιδεκάτου τῶν Νόμων, ὅπερ τινὲς Φιλόσοφον ἐπιγράφουσι.*

play no real part in the astronomical theory elaborated by Hipparchus and Ptolemy. We must never bring in the 'spheres' in dealing with the astronomy of Plato's dialogues. In the myth of Er in the *Republic* we hear only of the edges or lips (χειλη) of a set of 'whorls', one within another, and in the *Timaeus* only of circles. The framework of ψυχή into which the Demiurge fits the body of the οὐρανός must be pictured not as a sphere but as made by two circular hoops, one oblique to the other.

36 c 7–d 1. κράτος δ' ἔδωκεν . . . περιφορᾷ. περιφορά is here clearly used in its primary sense of 'revolution' not in the equally common derived sense 'orbit'. 'He gave the κράτος to the *revolution* of the Same'. The exact meaning of this will become clear directly as Timaeus goes on to expound his theory of the planetary motions. As a matter of language, κράτος means simply 'dominance' 'sovereignty'; the metaphor is from the relation of ruler and ruled in civil life. The Same is ὁ κρατῶν, the 'predominant partner' in the alliance or firm composed by the two 'circles'. So Thucydides talks of τὸ τῆς θαλάττης κράτος and τὸ κράτος τῆς γῆς where we say 'the superiority' at sea or on land, and cf. Aeschylus's Ἀχαιῶν δίθρονον κράτος, 'the joint-emperors of the Achaeans'.[1]

36 d 1–2. μίαν γὰρ . . . κύκλους ἀνίσους (κύκλους ἀνίσους, of course, an 'internal' accusative with σχίσας, 'split it into seven unequal circles by making a six-fold division'). The connexion of thought is that the reason why the circle of the Same has the κράτος, the 'upper hand', is that it is unsplit, while that of the Other is broken up into seven concentric separate bands. These bands, in fact, represent the orbits of the Moon, Sun, Venus, Mercury; (this is the order assumed later by Timaeus), Mars, Jupiter, Saturn, which all appear to lie in the same plane, that of the ecliptic. The *inequality* is explained in the next clause to refer to the difference of the breadth of the bands, i. e. of the distances between the 'planets'. As a mere matter of language the words 'seven unequal circles' *might* refer only to inequality of radii, i. e. of *orbits*, but we hardly need to be told that seven concentric circles forming a 'nest' are unequal in radius or circumference; that is obvious. What we do need to be told is that the *breadths* of the bands, i. e. the *differences* between pairs of adjacent radii are not equal. See the next note.

Aristotle falls foul of the whole passage 36 b 5–d 3 in *De Anima* A 406[b] 26 ff. when he is protesting against the ascription of 'motion' to the ψυχή. He has been complaining that various cosmologists, e. g. Democritus, had wrongly assumed that since the ψυχή causes movement in the body (a fact which Aristotle, of course, admits), it must itself be moving, and goes on thus: 'Timaeus too has a similar physical theory of the movement of the body by the soul, (φυσιολογεῖ τὴν ψυχὴν κινεῖν τὸ σῶμα). He holds that it moves the body *because* it is moving itself and has been entangled with the body (διὰ τὸ συμπεπλέχθαι πρὸς αὐτό, cf.

[1] In medieval astronomy and philosophy the κράτος of the 'circle of the Same' persists in the doctrine of the influence on all the processes of the universe of the diurnal revolution of the *primum mobile* (a 'sphere' which contains the ἀπλανές as well as the 'spheres' of the planets. The distinction between this first moving sphere and the ἀπλανές was made necessary in Alexandrian times when Hipparchus established the 'procession of the equinoxes'.) Cf. Dante *Paradiso* ii. 112 Dentro dal ciel della divina pace | Si gira un corpo, ne la cui virtute | L'esser di tutto suo contento giace.

διαπλακεῖσα, *Tim.* 36 e 2). For when it had been constructed from its στοιχεῖα (i.e. the three constituents named by Timaeus), and divided in accord with the numbers of the melodic progression (κατὰ τοὺς ἁρμονικοὺς ἀριθμούς), that it might have an innate perception of melody and that the movements of the Whole might be consonant, (the Creator), bent it out of the straight line into a circle. Then he divided the single circle into two with contact at two points (δισσαχῇ συνημμένους), and once more divided one of the two into seven. This presupposes that the orbits (φοράς) of the οὐρανός are the movements of the soul. Now, in the first place, it is not proper to call (οὐ καλῶς τὸ λέγειν) the soul a magnitude (μέγεθος, a *res extensa*). Clearly Timaeus means us to understand by the soul of the whole what is called 'Intelligence', whatever that is (οἷόν ποτ' ἐστὶν ὁ καλούμενος νοῦς); he cannot mean the 'sensitive' or the 'appetitive soul. Their motion is not circular revolution . . . [Ar. goes on to argue at length that νοῦς is not a *res extensa*, and then resumes, 407ª 18]. Besides, how will it think the divisible by means of what is indivisible or the indivisible by means of what is divisible? Yet this circle of which he speaks must be Intelligence (τὸν νοῦν). For thinking is the movement of Intelligence [i.e. according to Timaeus and Plato], and revolution the movement of a circle. So if thinking is revolution in a circle, the circle whose revolution is thinking must be Intelligence. But what is it that it can think about *for ever*, as it must,[1] since the revolution is everlasting? . . . [He then proceeds to argue that neither theoretical nor practical science is at all like this everlasting uniform repetition of the same orbit, since neither, however far you carry it, ever brings you back to your starting-point. He resumes again, 407 a 31.] 'Besides, if the same revolution is repeated, the same thought will have to be repeated too. And again thinking is more like resting and coming to a halt than it is like movement, and this is just as true of inference. Yet again it is not even a state of felicity (μακάριον) to move not easily but under constraint. And unless the very *essentia* (οὐσία) of the soul is motion, it must move under constraint (παρὰ φύσιν ἂν κινοῖτο). [I.e. the οὐρανός of Timaeus is not really what he calls it at 34 b 8 a εὐδαίμων θεός. Motion had not been specified as one of the constituents of the ψυχή, which were the Indivisible, the Divisible and the 'blend' of the two; any motion its ψυχή has is therefore adventitious and a *disturbance* of repose]. It is also a disagreeable (ἐπίπονον) lot to have been mixed up with the body without power of escape; nay more, it is a thing to be positively avoided (φευκτόν), if it is better for Intelligence not to be conjoined with a body, as is commonly said and as many agree in believing. [This is an attempt to appeal from the *Timaeus* to the doctrine of the *Phaedo* that death is a good thing because it is the deliverance of the ψυχή from the prison of the flesh.] And it is not clear what is the reason why the movement of the οὐρανός is circular. The *essentia* of the soul is not the reason for movement in a circle; it only moves in that way *per accidens*; [i.e. by Timaeus's own account the movements of the ψυχή are not circular because the ψυχή in its own nature

[1] Or, keeping τι for the τί of Simplicius in l. 22, 'And there will be something of which it is always thinking; there must be, since', &c.

must revolve in a circle; we are merely told that God gave it that movement, as if He might without any violence to its own nature have given it some other]; nor yet is the body the cause. It is rather the soul which causes the movement in that. [In fact, according to Timaeus's own narrative, 52 d—53 a, 'before' νοῦς set things in order the motions of the universe were irregular; νοῦς (48 a 3) introduced order by 'persuading necessity']. Yet again, it is not even said that it is better ⟨that the motion should be circular⟩. And yet the reason why God makes the soul revolve ought to be that it is better for it to be moving rather than at rest and to have this motion rather than any other.' [For Timaeus himself professes to account for the order of things by appealing to the *goodness* of God, and the *Phaedo* expressly says that the reason for every arrangement in the οὐρανός is that 'it is best that it should be so'. Aristotle can only mean that Timaeus does not in so many words repeat this explanation at the point where he speaks of the revolutions given to the two circles. He chooses to forget what had been said about the 'circular motion' at 34 a 1–5.]

The whole criticism, if it really is intended as serious censure of Plato, and not as a series of many verbal 'scores', turns, as Aristotle must have known, on taking poetical fancies literally and confusing 'likely tales' with science. Even as criticism of Timaeus, it would be merely captious; Timaeus *has* told us at 34 a 1–5 why the 'circular movement' is appropriate. It is only fair to Aristotle, in this as in many other cases we shall have to consider, to suppose that he knew that he was only 'talking for victory', and, like other lecturers, felt the need of relieving the tedium of scientific exposition by a 'little judicious levity'.

36 d 3–4. κατὰ τὴν τοῦ διπλασίου καὶ τριπλασίου διάστασιν ἑκάστην, οὐσῶν ἑκατέρων τριῶν. There are thus seven concentric 'orbits' in the now subdivided circle of the Other, and these seven orbits, in some way to be discovered directly, answer to the seven terms of the *double* progression from 1 to 8 and from 1 to 27. A whole series of questions suggests itself as to the precise sense of this. Are we to arrange the seven terms in their 'natural' order or in some other? What exactly is it that corresponds to them? Is it lengths or distances, or possibly something else? And if it is lengths, how are they supposed to be measured? Are we dealing with relative distances *from a centre*, the radii of the seven concentric circles, or are we dealing, as might be the case, with the distances of the circles *from one another*, i.e. with the breadth of different bands? And if the former, what is the common centre from which the distances are measured? Is it the centre of the earth or not? I.e. is the centre of the οὐρανός identical with the centre of the earth? If the latter, since there are seven circles, there can be only six differences of their radii, and the unit, which is the first term of the series, must therefore be a distance from the common centre, so that the question just mentioned returns again upon us. All these questions will have to be answered to the best of our power if we are to form a clear idea of the cosmical system Timaeus is expounding. And there is a more fundamental question. The progression is brought into the ψυχή of the οὐρανός 'before' that ψυχή is embodied at all. The order discernible in the heavenly bodies

answers to and reflects a more ultimate law of order of which the seat is the cosmic ψυχή, and we have thus to ask what character of the cosmic ψυχή is expressed by the construction. Before I attack these problems, I must just add a word or two on the verbal exegesis of the remaining lines of the paragraph, 36 d 4–7.

36 d 5–6. τάχει δὲ . . . ἀνομοίως. The astronomical meaning of this will be made clear by Timaeus himself in the sequel. As to the words, note that (1) ὁμοίως is here used in a mathematical sense not common in Attic. In old Ionic scientific prose ὅμοιος meant 'equal' (in classical Attic ἴσος), and it is a touch of correct historical colour that Timaeus should use the adverb in that sense here. Proclus tells us that the earliest geometers called 'equal angles' (ἴσαι γωνίαι) ὅμοιαι.[1] The expression is not classical Attic, and it is worth noting as one of the many Ionicisms of Aristotle that the phrase occurs several times in his cosmological writings.[2]

Note that the τάχος here does not mean what we call the velocity of a planet in its orbit. This varies from moment to moment, and the Greeks had no means of calculating it or averaging for a 'mean' velocity. What is meant is simply the *time* taken to complete one revolution. Two concentric revolving rings, which complete their revolution in the same time, have not the same 'velocity'. If their motions are uniform, any point on the circumference of the outer ring has a greater 'velocity' than any point on that of the inner, since it travels farther in the same time. But Timaeus ascribes the same τάχος to three such rings. So at 38 d 3 the circles of the Sun, Venus, Mercury are said to have the same τάχος, the meaning being that they are, as it is put there, ἰσόδρομοι; they 'breast the tape together'.[3] Timaeus holds that the three all complete their orbits in the same time; accordingly he says they have the same 'speed', neglecting the consideration that the runner on the outer of two tracks has farther to go than the runner on the inside track. Note that Timaeus is already talking of the τάχη though he has not yet mentioned the planets and will not mention them until 38 c 5. This is possible to him because he thinks of the circles themselves as revolving. He is guided all through by Anaximander's conception of the cart-wheels. Hence it is no violation of logical order, from his point of view, to consider the τάχη before he has even told us that there are any bodies in the seven 'circles'.

36 d 6. ἐν λόγῳ, 'in a ratio'.[3] The four other circles have 'speeds' which differ both from one another and from the common 'speed' of the

[1] Proclus *in Euclid* i (ed. Friedland pp. 250–1) λέγεται γὰρ δὴ πρῶτος ἐκεῖνος (Thales) ἐπιστῆσαι καὶ εἰπεῖν ὡς ἄρα παντὸς ἰσοσκελοῦς αἱ πρὸς τῇ βάσει γωνίαι ἴσαι εἰσίν, ἀρχαιότερον δὲ τὰς ἴσας ὁμοίας προσειρηκέναι.

[2] *De Caelo* B. 296^{b} 19 τὰ φερόμενα βάρη ἐπὶ ταύτην οὐ παρ' ἄλληλα φέρεται ἀλλὰ πρὸς ὁμοίας γωνίας (heavy bodies falling to the earth do not descend in parallel straight lines, but so as to make equal angles, i. e. vertically to the earth's surface at a given point), B. 297 b 18 πάντα φέρεται τὰ βαρέα πρὸς τὰς ὁμοίας γωνίας, Δ. 311 b 33 πρὸς ὁμοίας φαίνεται γωνίας τὸ μὲν πῦρ ἄνω φερόμενον, ἡ δὲ γῆ κάτω καὶ πᾶν τὸ βάρος ἔχον (fire moves vertically upward and earth vertically downwards). Compare the definition of a 'right' angle, Euclid i. *Def.* x. ὅταν δὲ εὐθεῖα ἐπ' εὐθεῖαν σταθεῖσα τὰς ἐφεξῆς γωνίας ἴσας ἀλλήλαις ποιεῖ, ὀρθὴ ἑκατέρα τῶν ἴσων γωνιῶν ἐστι.

[3] Cf. for this sense of 'velocity' Kant, *Werke*, ed. Hartenstein, iv. 374 (*Metaph. Anfangsgr. d. Naturwissenschaft*, c. 1, Expl. 2, n. 3).

three, but each of them has a ratio (λόγος) to every other. It is meant that these ratios are λόγοι ἀριθμῶν πρὸς ἀριθμούς, *rational* fractions, not surds. Timaeus never speaks of any ἀριθμοί which are not 'natural integers'. We know that *Plato* was prepared to call quadratic and cubic 'surds' numbers from the *Epinomis*[1] where they are expressly said to be ἀριθμοί, but in our dialogue the traditional Pythagorean restriction of the name ἀριθμός to the integers is kept up all through. (Remember that even in the *Elements* of Euclid, ἀριθμός always means 'natural integer'; 'surds' are always regarded as μεγέθη and represented by lines, areas, or volumes.) The τάχη of the various circles can all be represented by integers and the λόγος of one such τάχος to another by the λόγος of an integer (ἀριθμός) to an integer, i.e. by a 'rational fraction'.

We must now turn from the mere language of the passage to its meaning. Before we attempt the interpretation of details, it is important to begin with the most general question of all. Why is the ψυχή of the οὐρανός said to be constructed on the pattern of a scale? It is easy to answer that Timaeus has in mind the famous Pythagorean doctrine of the melody made by the heavenly bodies as they revolve. But before we deal with the astronomical details, we must remind ourselves that up to the present point in the dialogue we have heard of these circles simply as existing in the ψυχή of the οὐρανός. We do not reach the 'bodies' which the circles carry round until 38 c 5. The regularity of the celestial movements has thus to be understood as a consequence and embodiment of an orderliness which is more intimate and profound, and has its seat in the cosmic ψυχή. For the mere astronomy of the dialogue it would have been sufficient to construct the original progression with its seven terms, to answer to the seven 'planets'. Astronomically the remaining terms of the full progression of 34 numbers have nothing to correspond to them. Also we must remember that the ψυχή is constructed according to the great ἁρμονία before there has been any splitting of it into the circles of the Same and Other or any subdivision of the circle of the Other. The ἁρμονία is thus to be found whole and entire in the very structure of the cosmic ψυχή throughout its whole extent. The subdivision of the circle of the Other into seven, to correspond to the planetary orbits, is a fresh and subsequent procedure on the part of the Demiurge. Hence it should be clear that though the making of the ἁρμονία has plainly been suggested in the first instance by the 'music of the heavens', the significance of the thought is not exhausted by this astronomical theory. There must be a meaning which is more fundamental and universal than any planetary theory'. Undue concentration on the merely astronomical interpretation of the passage is, as it seems to me, a defect in Boeckh's

[1] *Epinomis* 990 d 1 ταῦτα δὲ μαθόντι τούτοις ἐφεξῆς ἐστιν ὃ καλοῦσι μὲν σφόδρα γελοῖον ὄνομα γεωμετρίαν, τῶν οὐκ ὄντων δὲ ὁμοίων ἀλλήλοις φύσει ἀριθμῶν ὁμοίωσις πρὸς τὴν τῶν ἐπιπέδων μοῖραν γεγονυῖά ἐστιν διαφανής . . . μετὰ δὲ ταύτην τοὺς τρὶς ηὐξημένους καὶ τῇ στερεᾷ φύσει ὁμοίους· τοὺς δὲ ἀνομοίους αὖ γεγονότας ἑτέρᾳ τέχνῃ ὁμοιοῖ κτλ. I am not satisfied that the text of this passage is wholly sound, but it is clear that the name ἀριθμοί is being given to both quadratic and cubic surds. About the care with which the study of 'irrationals' was prosecuted in the Academy there is no doubt. The tenth book of Euclid is the outcome of it. See Bt. *Greek Philosophy, Thales to Plato* 320–4, and G. Milhaud, *Les Philosophes-Géomètres de la Grèce* 327–87.

essay on the *Formation of the World-Soul*, the chief contribution of modern scholarship to the discussion of the passage.

If we turn to the ancient expositors, we shall find them more alive to the point. Plutarch first sets aside the views that the whole account of the great *ἁρμονία* is intended merely to embody an astronomical theory about the 'velocities' of the 'spheres' or their distances from the earth, or the volumes of the 'planets' in them, and then proceeds to make the following remarks.[1] 'Consider whether it is not by becoming most wise and righteous that the soul guides heaven and the heavenly bodies by her own proportions and motions; but she has become such (wise and righteous) by laws of modulation (*τοῖς καθ' ἁρμονίαν λόγοις*) of which there are indeed corporeal images in the seen and visible parts and bodies in the world. But the primary and fundamental quality thereof (*ἡ πρώτη καὶ κυριωτάτη δύναμις*) is invisibly blended (MSS. *ὁρατῶς ἐγκέκραται* but read with Müller *ἀοράτως*) into the soul and makes *her* concordant and obedient to the bridle, all within her being of one mind with her noblest and divinest part.' Thus Plutarch regards the whole description of the *ἁρμονία* from 35 b 4 to 36 b 5 as a way of saying that God put wisdom and order into the world's soul and that the outward rule of 'unalterable law', which astronomy reveals in the system of the heavenly bodies, is a visible consequence and sign of the goodness and wisdom of the soul which presides over the great cosmic movements. Timaeus would thus be teaching the very doctrine set forth without any admixture of Pythagorean fancies as the central dogma of the natural theology of *Laws* x, that the 'reign of law' in the visible heavens is due to a wise and good soul which is the cause of 'orderly' motions.

Chalcidius gives a slightly different exposition. Plato means that the cosmic *ψυχή* can know all things 'as well intelligibles as sensibles'. Now it is a doctrine of the Pythagoreans that like is only known by its like, as Empedocles, following them, says in his poem. So Plato, asserting the same doctrine, makes the soul out of all the elements (*initia*) that it might have cognizance of the elements themselves and their consequences, and so of everything, and make judgements about everything'. (This reproduces Crantor's interpretation of the *ψυχογονία*).[2]

[1] Plut. *de animae Procreatione* 1029 d e *σκοπεῖτε δὲ μὴ τὸν μὲν οὐρανὸν ἄγει καὶ τὰ οὐράνια ταῖς περὶ αὐτὴν* (l. *αὑτὴν* with Bernardakis in his note), *ἐμμελείαις καὶ κινήσεσιν ἡ ψυχὴ φρονιμωτάτη καὶ δικαιοτάτη γεγονυῖα· γέγονε δὲ τοιαύτη τοῖς καθ' ἁρμονίαν λόγοις, ὧν εἰκόνες μὲν ὑπάρχουσιν εἰς τὰ σώματα* (so MSS., Bernardakis adopts the conjecture *ἀσώματα*, apparently joining *εἰκονές* with *εἰς τὰ ἀσώματα*; there seems to be something wrong with the text, but *ἀσώματα* can hardly be right) *ἐν τοῖς ὁρατοῖς καὶ ὁρωμένοις μέρεσι τοῦ κόσμου καὶ σώμασιν· ἡ δὲ πρώτη καὶ κυριωτάτη δύναμις ὁρατῶς* (l. *ἀοράτως*) *ἐγκέκραται τῇ ψυχῇ καὶ παρέχει σύμφωνον ἑαυτὴν* (l. *αὐτὴν* or *⟨αὐτῇ⟩ αὐτὴν*) *καὶ πειθήνιον, ἀεὶ τῷ κρατίστῳ καὶ θειοτάτῳ μέρει τῶν ἄλλων ἁπάντων ὁμονοούντων.* (Qy. should the comma be removed from after *πειθήνιον* and placed after *μέρει*?).

[2] Chalcidius *Comment.* § 51 (ed. Wrobel p. 119). The particular point Ch. is labouring is Plato's reason for allowing the *λεῖμμα* in his progression. Vult igitur animam sensibilis mundi tamquam permissa usurpandi licentia nasci, congnitricem tamen rerum omnium quae sunt tam intellegibiles quam sensibiles. Est porro Pythagoricum dogma simile nonnisi a similibus suis comprehendi. Quod etiam Empedocles sequens ait in suis uersibus. . . . Atque ipse etiam Plato hoc ipsum adserens animam ex omnibus initiis conflat ut et ipsorum initiorum et quae initia sequuntur et prorsus omnium rerum existentium scia esset ut de omnibus iudicaret.

The speculations of Proclus on the significance of the *ἁρμονία* are unfortunately vitiated by his desire to read into Plato his own theories about the hierarchy of souls and also to find a Platonic interpretation of the stories (reprobated by Socrates in the *Republic*) of the *ἐκτομαί* and *δεσμοί* inflicted on the gods by one another. (See *Comment* ed. Diehl ii. 207–31.) He fully recognizes that the Pythagorean 'music of the heavens' does not exhaust the meaning of the passage. Thus (ii. 207–8) he discovers that the reason for the great compass of the *ἁρμονία* is that (1) its four octaves stand for the inner *ἁρμονία* in the soul itself, (*ψυχή* standing to *νοῦς* as 4 'the tetractys' stands to 1 'the unit'); the remaining major fifth alludes to the 5 regular solids, and the extra tone, which is added to make up the interval of the sixth, indicates that the soul is not merely itself orderly but is *σύμμετρος* with the order in the outer world.

To those who were content to see in the whole story a mere disguised piece of astronomy, a speculation about the distances of the 'circles' from the earth, or the 'velocities' or magnitudes of the heavenly bodies, he objects (ii. 212) (*a*) that the results got by such an interpretation do not tally with more modern results based on careful observation, (*b*) that Plato never commits himself to rash positive assertions on such matters, (*c*)—and this is the real point—that a psychogony is one thing, a cosmogony another. As an illustration of his correct perception that the *ἁρμονία*, whatever it stands for, must be characteristic of every 'part' of the cosmic *ψυχή*, I may quote the view he develops at *op. cit.* ii. 229–30. He finds the intervals of the fifth, fourth, tone, and the *λεῖμμα* everywhere by maintaining that in every 'sphere' we may distinguish four sets of *ζῷα*, the 'sphere' itself, gods or *θεῖα ζῷα*, 'daemons' *δαιμόνια ζῷα*, souls, *ψυχικὰ ζῷα*. These four, he says, correspond to the intervals of the tetrachord; the *δαιμονία ζῷα*, being less exalted above the *ψυχικὰ ζῷα* than the *θεῖα ζῷα* are above them, or the 'sphere' itself above the *θεῖα ζῷα*, we may regard the interval between 'daemons' and 'souls' as answering to the *least* of Plato's melodic intervals, the *λεῖμμα*! Or, if we like, we may get in a meaning for the *λεῖμμα* in a different way (ii. 231). There are 'effluxes' from all 'spheres' to the subterranean realm, which thus contains a sort of sediment or lees of all the 'spheres', and even this, as a *λεῖμμα*, contributes to make the whole melody complete! By interpolating a tone in the cosmic tetrachord for the 'heroes' who stand midway between 'daemons' and ordinary souls we get the *διὰ πέντε*.

If we put together the suggestions of Plutarch and Chalcidius we get, I think, a satisfactory clue to Plato's meaning. The soul in Plato, and in the doctrine he ascribes to Timaeus, has to do two things, like *νοῦς* in the philosophy of Anaxagoras. It must be the source of all motion, or, as Anaxagoras put it, must 'prevail' over (*κρατεῖν*) everything. (It is the use of the word *κρατεῖν* by men of science of the fifth century like Anaxagoras and Diogenes of Apollonia[1] which explains what Timaeus

[1] Anaxagoras Fr. 12 *τὰ μὲν ἄλλα παντὸς μοῖραν μετέχει, νοῦς δέ ἐστιν ἄπειρον καὶ αὐτοκρατὲς* (its own master 'responsible to no one') *καὶ μέμεικται οὐδενὶ χρήματι, ἀλλὰ μόνος αὐτὸς ἐπ' ἑωυτοῦ ἐστιν. εἰ μὴ γὰρ ἐφ' ἑαυτοῦ ἦν ἀλλά τεῳ ἐμέμεικτο ἄλλῳ, μετεῖχεν ἂν ἁπάντων χρημάτων, εἰ ἐμέμεικτό τεῳ . . . καὶ ἂν ἐκώλυεν αὐτὸν τὰ συμμε-*

means when he says that God gave the κράτος to the circle of the same.) Also the soul must *know* about everything, or there would be fixed limits to science. The primary body in all ancient systems was supposed to 'know' everything, and that is why the Fire of Heraclitus, though it is just, real fire is called 'all wise' and perhaps said to 'know all things'.[1] Now, on the assumption that 'like is only known by like', which seems never to have been disputed until Anaxagoras started the rival theory of 'perception by opposites', that which knows everything must somehow be made of the same stuff as the things it knows. Timaeus, who distinguishes sharply between ψυχή and σῶμα, cannot understand this principle in the original crudely materialistic sense. But he retains the spirit of the doctrine by teaching that as regards its *formal structure* the soul which knows the laws and proportions of all things is itself a thing which has an intrinsic law of proportion in its own constitution. Similarly he does not accept in all its unqualified crudity the saying of Anaxagoras that Mind must be 'unmixed' with anything else in order that it may 'prevail' over everything, but the thought is preserved in the form that if Mind is to be the cause of *orderly* motion in other things, it must have law and order in itself. In respect of its *formal* structure, there must be a *correspondence* between the ψυχή and the things it knows and moves. If it is to *find* 'system' in things it must first have 'system' in itself, and again, if it is to *put* 'system' into things, it must likewise itself *be* a 'system'. This, I take it, is what the parable of the construction of the ἁρμονία is, as a whole, meant to teach.

Next a word about the significance of the κράτος given to the circle of the Same. Of course there is an astronomical meaning, with which we shall be concerned directly. But the astronomical special meaning can hardly be the whole meaning, since the circles are primarily characters of the cosmic ψυχή; the astronomical sense must thus be concerned with consequences of something still more ultimate. There may be a hint, as Proclus thought, that in a system with a definite structure and definite laws, 'the identity' or 'permanence of form' of the whole system is more important than the superficial variety of 'material' constituents.

μεμιγμένα, ὥστε μηδενὸς χρήματος κρατεῖν ὁμοίως ὡς καὶ μόνον ἐόντα ἐφ' ἑαυτοῦ . . . καὶ γνώμην γε περὶ παντὸς πᾶσαν ἴσχει καὶ ἰσχύει μέγιστον, καὶ ὅσα γε ψυχὴν ἔχει καὶ μείζω καὶ ἐλάσσω, πάντων νοῦς κρατεῖ. καὶ τῆς περιχωρήσιος τῆς συμπάσης νοῦς ἐκράτησεν, ὥστε περιχωρῆσαι τὴν ἀρχήν (R. P. 155). The last clause shows exactly what Anaxagoras meant by the κράτος of νοῦς; it was just its power to start motion. The fragment explicitly couples together for the first time as propria of Mind, knowledge and this power to initiate motion. Diogenes Apoll. Fr. 5 (Diels) καί μοι δοκεῖ τὸ τὴν νόησιν ἔχον εἶναι ὁ ἀὴρ καλούμενος ὑπὸ τῶν ἀνθρώπων καὶ ὑπὸ τούτου πάντας καὶ κυβερνᾶσθαι καὶ πάντων κρατεῖν, R. P. 211). The reason why we do not hear of this power to start motion before Anaxagoras is, as Bt. has said, that until the time of Parmenides and Zeno no one had felt any difficulty on the point. Motion had been taken, as it is in the recent philosophical systems of H. Bergson and Prof. Alexander, as ultimate and self-explanatory. It was rest, arrest of motion, that was felt to demand a 'cause'.

[1] Heraclit. Fr. 32 Diels = 20 Bywater ἓν τὸ σοφὸν μοῦνον λέγεσθαι οὐκ ἐθέλει καὶ ἐθέλει Ζηνὸς ὄνομα (R. P. 40). Fr. 50 Diels = 1 Bywater οὐκ ἐμοῦ ἀλλὰ τοῦ λόγου ἀκούσαντας ὁμολογεῖν σοφόν ἐστιν ἓν πάντα εἶναι (R. P. 40), where εἶναι, accepted by both Diels and Bywater, is a conjectural alteration of MS. εἰδέναι.

The world seems to contain endless diversity, but on a closer view we see that everywhere the diversity is controlled by the unity of pattern or ground-plan. It is literally true of the physicist's world at least as much as of the historian's that *plus ça change, plus c'est la même chose*. And, again, it is just superior insight into the sameness of the formal laws amid all the bewildering variety of 'empirical' facts which distinguishes the supreme man of science, as even popular tradition recognizes when it represents the contents of Newton's *Principia*, as summed up by the *aperçu* that the moon falls towards the earth in the same fashion as an apple dropping from the tree. Still what is mainly prominent in the mind of Timaeus is, no doubt, the astronomical application, and to this we may now turn.

The general scheme of the astronomy is plain enough. The circle of the Same represents the sidereal equator and its movement is the apparent diurnal revolution of the whole heaven in virtue of which any star—if we neglect the difference in length between the solar and the sidereal day, of which Timaeus could know nothing—crosses the meridian at intervals of twenty-four hours. The circle of the Other represents the apparent annual path of the sun through the Zodiac and the corresponding paths of the various planets with their different 'years' or periods. The circle of the Other is broken up into seven concentric circles to correspond to the seven 'planets', Moon, Sun, Venus, Mercury (this is the order assumed by Timaeus), Mars, Jupiter, Saturn. The circles revolve in opposite senses because, as seen from the earth, the daily revolution is from east to west, but the paths of the planets through the Zodiac are traversed from west to east. So far everything is plain sailing, and the only comment one might be moved to make is that the cart-wheel imagery which goes back to Anaximander is a little inappropriate as far as regards the diurnal revolution, since the stars do not lie with their centres all in one plane. Their movement would be much better represented, after the fashion of Eudoxus, by the rotation of a sphere on its axis than by the revolution of a circular ring.[1] When we come to consider the astronomical signi-

[1] This is so obvious that I cannot help thinking Bt. right in his recent suggestion that Anaximander's 'wheel of the stars' was really meant to explain the movements of φώσφόρος and ἕσπερος, not yet recognized as the same planet. (The tradition ascribes the identification variously to Pythagoras and to Parmenides, which probably means that the earliest literary work in which it was mentioned was the second part of the poem of Parmenides.) On this hypothesis we understand, what would otherwise be rather puzzling, that the wheel of the 'stars' was supposed by Anaximander to have the smallest diameter and so to be nearest to us. The real 'stars' will then be entirely outside the system of 'wheels', and we must suppose that they do not belong to our οὐρανός at all, but are themselves the ἄπειροι οὐρανοί which Anaximander believed to be encompassed by his 'boundless'. See on the whole theory the discussion of *EGPh.*[3] 68–70. It will follow that with the subsequent reduction of the number of οὐρανοί to one and the inclusion of the true stars within the one οὐρανός, the coherency of the scheme of the circles is destroyed; we really ought not to have a single circle of the Same but a set of circles of steadily diminishing diameter in planes parallel to the Equator; but there is nothing strange in the retention of a guiding image long after it has become really inadequate. Our modern physicists do not shrink from still talking of 'atoms', though they tell us in the same breath that each of these 'indivisibles' is to be thought of as a whole constellation of still more minute components.

ficance of the statements about the correspondence between the seven divisions of the circle of the Other and the seven terms of the double geometrical progression, and to ask exactly how Timaeus conceives of the music of the heavens we are on more debatable ground and shall need to proceed carefully.

In the first place, it is clear that Timaeus means to say that there is something connected with the seven planets, or with their orbits, which corresponds to the terms of the progressions represented by the 'lambda-like figure'. But what is this something? As we learn from both Plutarch and Proclus, there were at least three different views about this. Some held that the seven numbers refer to the relative magnitudes of the planets, some that they stand for their relative 'velocities' (τάχη), some that they have to do with relative distances. The second of these views is clearly quite inadmissible. For, as we have seen, the only τάχη mentioned in the dialogue are simply the periods of the planets. The accepted view about these was that the Moon's period is one month, the Sun's one year, those of Venus and Mercury the same as the Sun's, the period of Mars two years, that of Jupiter twelve, that of Saturn thirty.[1] As Proclus says, these numbers do not exhibit anything like the ratios of Plato's series. No one could possibly suppose that the year is to the month as 1 to 2, and no one could be guilty of the absurdity of saying both that the Sun, Venus, and Mercury all have the same τάχος and also that their τάχη are in the ratios of the numbers 2, 3, 4. An equally cogent argument enables us to exclude all possibility of a reference to the magnitudes of the planets. Of course in the fifth century there was no means of determining the true magnitudes, nor, I take it, is there any means of determining them now except by first discovering the relative distances of the planets from us. One might, however, imagine an illusory way of solving the problem. It might conceivably be fancied that the *brightnesses* of the planets are proportional to their magnitudes, and it would be possible to make out an order of relative brightness.[2] But, as we have

[1] These were the accepted figures for the periods of the planets in the middle of the fourth century. See the long account of the astronomical scheme of Eudoxus given by Simplicius in his commentary on *De Caelo* B. 293[a] 4, an account which goes back ultimately to Eudemus.

[2] There is a curious example in antiquity of such an attempt to arrange the 'planets' in an order of brightness. In *Rep.* 616 e (myth of Er) there is a series of statements about the 'breadth' of the 'lips' of the concentric 'wheels' which represent the orbits of the heavenly bodies. According to the unanimous text of our MSS. the order of breadth is ἀπλανές (circle of the 'stars'), Venus, Mars, Moon, Sun, Mercury, Jupiter, Saturn. It has always been a mystery what 'appearances' this order is meant to explain. (See the discussion in the *Excursus* on the passage in Adam's edition.) Proclus, however, knew of a variant reading of the passage which gives the order ἀπλανές, Sun, Moon, Venus, Mars, Jupiter, Saturn, Mercury (Procl. *in Remp.* ed. Kroll ii. 217, 218). This order, Proclus says, is meant to make the 'breadths' (the distances from one circle to the next) correspond to the magnitude of the bodies the circles contain, and it seems clear that his explanation is correct. The ἀπλανές is placed first, no doubt, because of the great number of the stars, which taken together must make up a volume greater than that of any planet; the remaining circles are obviously arranged in the order of apparent brightness, though it is curious that Mars should be placed before Jupiter. Proclus thought *this* version of the text the 'older' and more genuine, but he was plainly mistaken. It ought to be clear that it is an

so far heard nothing of the bodies which are to be ultimately placed in the circles, we clearly have no right to suppose that their brightness is being taken into account. We are dealing with the circles themselves, and with them only. If we are careful to remember this, we can hardly suppose that the subdivision of the circle of the Other 'in accord with the intervals' of the progression refers to anything but distances. And it is plain from what point the distances are supposed to be measured. They must be distances from the common centre of the concentric circles, i. e. from the supposed centre of the universe, since this is the only point which is unambiguously determined by the information with which Timaeus has so far supplied us. This consideration has no bearing on the important question, to be considered later, whether the earth is supposed to be 'at rest' in the 'centre' or not. Even if it is moving, it is clear from the simple consideration that there are seven and not eight divisions of the circle of the Other, that it is not revolving in a circle, and, as we shall see later, the earth is, at any rate, supposed to be quite near the 'centre'. So that the distances of planets from the 'centre' will also be, within the limits of reasonable approximation, their distances from us, even if our earth is executing a movement of some sort.

We thus arrive at the general result that the planetary distances are in some way proportional to the terms of the series 1, 2, 3, 4, 8, 9, 27.[1] Yet there is still an ambiguity to be cleared up. Is Timaeus comparing the actual *radii* of the planetary orbits, or is he comparing the distances from each planet to the next? Does he mean, for example, that the sun's

attempt to correct the puzzling order given in what Proclus took to be the 'later' text into something more intelligible. And there is excellent external evidence for the text as it stands in our MSS. It is quoted by Theon of Smyrna in his remarks on the myth of Er (ed. Hiller, p. 145). As Theon mentions no other text, presumably he knew of none. From a later passage of Theon (*op. cit.* 198. 19) we find that he made use of an exegesis of the astronomy of the myth by Dercylides, the scholar who appears to be ultimately responsible for fixing the Platonic text as it has been handed down to us. (The date of Dercylides is not exactly known, but seems to be certainly not later and possibly earlier than that of Thrasyllus, who made the familiar arrangement of the dialogues into tetralogies in the time of Augustus or Tiberius.) We may therefore conclude with reasonable certainty that the text of our MSS. of *Rep.* 616 e was that of Dercylides, and that the variant readings supplied by Proclus were introduced *after* the time of Theon (the age of Hadrian) and before that of Proclus. The MSS. text should therefore be accepted as the only really authenticated one. I confess I am entirely at a loss to understand what the order it gives is meant to represent. It is hard to acquiesce in Adam's view that it is a mere arithmetical *jeu d'esprit*; it ought to stand for something which can be detected in the 'appearances', but for what? Proclus thought (*loc. cit.*) that the arrangement was based on views about the apogees and perigees of the planets, but since the myth of Er represents the planets as describing circular orbits with the earth at the common centre, there is really no room in it for apogee or perigee. Proclus should not have allowed himself to forget his own correct refusal in other places to admit 'eccentrics' or 'epicycles' into Platonic astronomy.

[1] If we are dealing with distances it is almost inevitable to assume that the terms of the series are arranged in the 'natural order', and that 8 must come before 9, though in the original 'lambda-like figure' 8, being a third power, would naturally be regarded as *after* 9, which is a second power. This is one of the considerations which explain why the early Academics were not agreed on the question whether the two-power series should be figured along the limbs of a Λ (Crantor) or along one straight line (Theodorus). As soon as we pass to the 'filling up of the 4 : 3 intervals' we need to drop the Λ altogether.

distance from the centre is twice, that of Saturn twenty-seven times, that of the moon? Or does he mean that the sun is twice as far from the moon as the moon is from the centre, Saturn twenty-seven times as far from the centre as the next nearer planet, Jupiter? This second view had its defenders in late antiquity. Macrobius gives it (*in Somnium Scipionis* ii. 3. 13) unhesitatingly as that of the Platonicii, quoting Porphyry in particular as his authority. It is clear, however, I think, that Porphyry was wrong in this interpretation. Recur, for a moment, to the 'tuned string' which underlies the whole construction of the *ἁρμονία*. If you have a string of length AB and divide it at C so that $AC = CB$ and $AB = 2\,AC$, the notes given out respectively by AC and AB will form the *διὰ πασῶν* or octave. But if you make $CB = 2\,AC$, so that AC is $\frac{1}{3}\,AB$, the notes given out by AC and AB will not form an octave at all; but an octave and a fifth (the *διὰ πασῶν καὶ πέντε*). Or, in other words, to get the *ἁρμονία* of Timaeus you must suppose that the original long string produced by the Demiurge is not a single continuous string 'stopped' at different points, so that the whole string and its sections execute a series of harmonic vibrations, but a set of distinct strings each of which vibrates separately. Or, if you suppose the string to be continuous, the ratios corresponding to its subdivisions, on the theory of Porphyry, will be those of the successive terms of the series 1, 3, 15, 65, 385, 5,850, 117,000. One may also mention the point that in Porphyry's view, the distance measured is in all cases but one the 'breadth of a band', the *difference* between the radii of two planetary orbits; but in the case of the innermost 'planet', the moon, it must be not a difference but an actual radius, the distance of the moon from the 'centre', and thus there is a want of symmetry about the whole procedure which is not likely to be intended. I take it, then, that it is the distances of the planets from the centre, not the distances from one another, which correspond to the terms of the progression. I. e. Timaeus is giving us an estimate of the radii of the planetary orbits in terms of the diameter of the moon's orbit. This is exactly what we should expect when we remember that the origin of the whole scheme is to be found in Anaximander's cart-wheels. According to Anaximander the wheel of the moon was eighteen times the size of the 'earth' i. e. of the disk-like surface of the earth, that of the sun twenty-seven times the size of the earth, and we may reasonably infer that the wheel of the 'stars' was nine times the size of the earth. (See *Placita* ii. 20. 1 = R. P. 19 a, ii. 25. 1 = R. P. 20 b and *EGPh.*[3] 68.) We see here the beginning of the attempt to represent celestial orbits by the terms of a geometrical progression, and we see also that it is actual distances from the common centre of the *οὐρανός* which answer to the terms of the progression, as it should be. There is, however, a notable difference between Timaeus and Anaximander which should not be overlooked. Anaximander takes as his unit of measurement the radius of the earth's disc, Timaeus that of the moon's orbit. About the size of the earth Timaeus expresses no opinion at all. Two reasons may be given with great probability for this difference. (1) By the middle of the fifth century it was well understood by some at any rate that they had no sufficient information about the size of the earth. Plato makes Socrates

say in the myth of the *Phaedo* that the οἰκουμένη is only a very small part of the 'true surface' of our globe (*Phaedo* 109 a 9 πάμμεγά τι εἶναι αὐτὸ καὶ ἡμᾶς οἰκεῖν . . . ἐν σμικρῷ τινι μορίῳ), and in view of the abundant evidence that the cosmology of this myth is Pythagorean and in all probability based on Philolaus (see the detailed grounds for this view in Burnet's annotated edition *ad loc.*), we may fairly suppose that the opinion of Socrates on the matter was shared by eminent Pythagoreans of his own time. (2) A more important point is that Anaximander clearly ascribed a circular revolution to the earth itself. As the earth in his system is in the centre of a cosmic 'eddy' (δίνη) of course all points on its disc except the actual centre are turning round, though more slowly than the 'wheels' which are farther away from the centre. In fact, so far as the surface on which we live is concerned, it behaves itself exactly like an innermost 'wheel'.[1] Now, whatever Timaeus means to say about the earth, he certainly does not ascribe a 'cart-wheel' motion to it; it is not one of the 'planets'. If it were, there would have to be eight and not seven planetary circles. It is natural therefore that he should use as his unit of measurement the radius of the innermost wheel of his system, and make no attempt at a comparison with the size of the earth.

It should also be noted that, since the orbits which have been correlated with the terms of the 'double and triple progression' all belong to the 'circle of the Other', Timaeus prudently abstains from saying anything about the distance of the ἀπλανές from the 'centre', or, what is the same thing, the size of the οὐρανός. The true stars must be farther from the centre than the remotest planet, but Timaeus allows us to suppose them as much farther away as we please. His οὐρανός is bounded, has a centre and a circumference, but nothing in his account justifies William James's language about the supposed bias of the Greek mind for a 'tiny' universe.

We have now reached a point where we can return to the astronomical significance of the 'music of the heavens'. The roots of the idea are obviously already present in Anaximander's cosmological theory. If you think of the heavenly movements on the analogy of revolving cart-wheels, it is a natural thought that the revolving circles give out notes of different pitch. And when once the discovery of Pythagoras that the fundamental musical intervals correspond to simple numerical ratios had been made by men already familiar with Anaximander's view, it was natural to

[1] See the full explanation of Anaximander's cosmology in *EGPh.*[3] 66 ff. No modern historian of Greek science (not even Bt. in the earlier editions of *EGPh.*) had previously observed not only that the rotation of the earth is a necessary part of the scheme but that we have the unimpeachable evidence of Eudemus (*op. cit.* 66 n. 3) to the fact that 'Anaximander holds that the earth . . . moves round the centre'. It is of the first importance to recognize that Greek science *started* with a moving earth. As Anaxagoras taught the same thing and explained that the heavenly bodies have actually been detached from the earth by its rapid rotation (cf. the modern theories about the formation of the moon), the doctrine was presumably retained as part of the Ionic tradition. Those Pythagoreans who went a step further and said that the earth is a planet were not so much daring innovators as developers of the original tradition of Greek science. It is the absolutely stationary earth which is an innovation, and a most unfortunate one.

suppose that the notes will answer to the intervals of a regular musical scale. Originally, it can hardly be doubted, the thought must have taken the form that, as there are seven circles of the planets and an eighth, the 'outermost Olympus', as the Pythagoreans called it, of the stars, the scale of the celestial melody forms a διὰ πασῶν or octave. With Timaeus, whose progression runs from 1 to 27, the scale has a much greater compass; it embraces four octaves and a sixth. Hence Boeckh's attempts to reconstruct the scale, so as to assign to each circle its precise place in the octave, is hardly relevant to the theory of Timaeus in particular, and also is vitiated by the very grave doubt whether the authorities on whom he depends can be trusted not to have credited early Pythagoreans with a much more developed musical theory than they really possessed. There is, however, a difficulty which must be considered because it is connected with a central feature of Timaeus's doctrine, the astronomical consequences of the κράτος bestowed on the 'circle of the Same'. Since Anaximander, who is really at the bottom of the ideas we are examining, held the revolutions of his 'wheels' to be set up by an 'eddy' in the 'boundless' (see *EGPh.*[3] 61–2 and the essay of Prof. Heidel referred to there at p. 62 n. 1), it follows that the original view must have been that all the wheels revolve in the same sense, presumably from E. to W., the sense of the regular 'diurnal motion'. On this view, the ἀπλανές will, of course, be the swiftest of the circles, since it makes a complete revolution once in twenty-four hours. Saturn, which takes roughly thirty years to complete its orbit through the signs of the Zodiac and thus only performs about $\frac{1}{30}°$ of its revolution in the day, will be the next swiftest as it only 'falls behind' the ἀπλανές daily to that trifling extent; the remaining planets, as we go inwards, will exhibit a growing diminution of speed, and the moon, which goes the round of the Zodiac in a month, will 'fall behind' the ἀπλανές roughly 12° daily and so be the 'slowest' of all. From this point of view it is possible to work out two quite different theories about the cosmic melody with equal consistency. On the one hand, the longer a vibrating string the deeper is the note it gives out. If you follow this analogy, the moon should give out the highest note of the scale, each succeeding planet should give out a deeper note than the next innermost, and the ἀπλανές should have the deepest note of all. The moon should thus correspond to the νήτη, the ἀπλανές to the ὑπάτη on a lyre (or more strictly, on the old Greek lyre, the moon should be νήτη, Saturn ὑπάτη, and the ἀπλανές what was called the προσλαμβανόμενος, the 'extra' tone added to complete the διὰ πασῶν). This is the view Milton follows when he speaks of the 'bass of Heaven's deep organ', by which he means the note of the ἀπλανές (using οὐρανός in the peculiarly Pythagorean sense), as added to the tones of the 'crystal spheres' of the planets to complete the octave. On the other hand, the Greeks of the fifth century knew in a confused way that higher notes correspond to swifter, lower notes to slower, motions. (We shall find Timaeus himself making this knowledge the basis of a curious speculation at 80 a–b.) If we follow this analogy, still retaining the theory of the revolution of all the 'wheels' in the same sense, which compels us to regard Saturn as the 'swiftest', the moon as the 'slowest'

planet, we get the opposite result. The ἀπλανές, being the swiftest of the circles, will have the highest note, Saturn will have the next highest, the moon the lowest of all. Both analogies seem equally natural, and on either you get as you go outwards from the 'centre' the successive intervals of a regular scale, a descending scale on the first view, an ascending scale on the second. It is interesting to find that both views were actually put forward, though the predominant view, and particularly that which the expositors of Plato seem to have found in the *Timaeus* and the myth of Er in the *Republic*, was that the moon has the lowest note and the ἀπλανές the highest.[1]

Which of the two views, we may ask, is that of Timaeus? I think it is

[1] See *EGPh.*[3] 306–7 with the references given there. Cicero (*Somnium Scipionis* v. 18) gives the lowest note to the moon, the highest to the ἀπλανές, 'ille caeli stellifer cursus cuius conversio est concitatior acute et excitato movetur sono, gravissimo autem hic lunaris atque infimus'. His commentator Macrobius (*in Somn. Scip.* ii. 4. 4) repeats the same view. Theon of Smyrna (p. 140 Hiller) quotes a set of verses which he ascribes to Alexander of Aetolia, a court poet of Ptolemy Philadelphus, in the early third century. As Chalcidius, who quotes a Latin version of the same lines, attributes them to Alexander *Milesius*, it has been common of late years to suppose that Theon made a mistake, and that the real author is either Alexander Polyhistor or Alexander of Ephesus (which brings us down to the first century B.C.). These lines give the lowest note to the *earth* (γαῖα μὲν οὖν ὑπάτη τε βαρεῖά τε μέσσοθι ναίει) and the highest to the ἀπλανές, assigning intermediate notes to the various planets. Theon rightly says that the verses give one note too many, and that some of the intervals assigned will not occur in a diatonic διὰ πασῶν. He also adds that if the earth is at rest, as the words μέσσοθι ναίει seem to imply, it cannot give out a note at all (*op. cit.* p. 142 φαίνεται ὁ ἀνὴρ οὗτος τὴν μὲν γῆν ἐῶν ἀκίνητον, ἐν ᾗ δὲ φθόγγοις ποιεῖ ὑπὸ τὴν τῶν ἀπλανῶν σφαῖραν τὰς τῶν πλανωμένων ἑπτά). This is true; but whoever wrote the lines has preserved what must have been the genuine original doctrine. If the earth goes round in the δίνη, as Anaximander certainly must have held, of course it gives out a note. Originally it must have been the ἀπλανές which did not contribute to the music; the contradiction noted by Theon arises from a combination of the really earliest view with the later view which keeps the earth at rest, and so has to take in the ἀπλανές to make up the octave.

Plutarch (*de anim. Procreat.* 1028 f.) mentions that 'some' suppose the moon to answer to the ὑπάτη, and regard the earth as corresponding to a προσλαμβανόμενος, or extra tone, below the ὑπάτη (ἔνιοι δὲ γῇ μὲν τὴν τοῦ προσλαμβανομένου χώραν ἀποδιδόντες, σελήνῃ δὲ τὴν ὑπάτην κτλ.). But he objects to this that Plato, δῆλός ἐστιν ἐπὶ τὸ ὀξὺ προσλαμβάνων (ib. 1029 c), takes the extra tone at the other end of the scale. He appeals for proof of this to *Rep.* x. 617 b, where a Siren is said to stand on each of the eight 'circles' (miscalled by Plutarch 'spheres') uttering her note. It would thus appear that Plutarch also gives the lowest note to the moon. His disagreement with the ἔνιοι is merely that the 'extra tone' required to complete the octave should be added on at the upper end. I.e. the διὰ πασῶν of eight notes is got by seven planets + ἀπλανές, not by earth + seven planets. The unnamed ἔνιοι had still a lingering recollection that the original version of the scale included the earth.

Nicomachus of Gerasa also mentions the existence of the two views (Jan *Scriptores Musici* 271) διότι καὶ ὁ ♄ (the astronomical symbol for Saturn), ὕπατος καὶ πρῶτος ἀπὸ τῆς ἀπλανοῦς . . . οἱ δὲ δὴ πρῶτοι ἀπὸ τῶν πρὸς ἡμᾶς ἀρξάμενοι ὑπάτην μέν φασι τὸν πρῶτον τὸν τῆς Σελήνης ὡς ἂν ἀρχὴν φθόγγων, νεάτην δὲ ὡς ἐσχάτην ἀφ' ἡμῶν τὴν τοῦ Κρόνου. At p. 273 N. points out that the second view, adopted by himself, is demanded by the 'double motion' theory. Jan (*op. cit.* 120 ff.) holds that the change of view took place in Alexandrian times, the connexion between high pitch and rapid movement having only been discovered by Archytas and Heraclides of Pontus. His reasons do not seem to carry much weight. Timaeus shows himself alive to the point *infra* 80 a–b, and N. seems to represent his own view as that which had always prevailed with the Pythagoreans.

clear that we must suppose him to be following the view which makes the swiftest circles give out the highest notes. For one thing, we can hardly doubt that he means the ἀπλανές to contribute to the music, and, as we have seen, he leaves the distance of the ἀπλανές from the 'centre' wholly undetermined. This, of itself, makes it most unlikely that he connects the notes of the circles primarily with their distances. The repeated stress which he lays on their τάχη, taken in connexion with his own express use for another purpose of the proposition that swift motions are connected with high notes, points in the same direction. And when we remember that the notes are not supposed to be actually made by vibrating chords but by rotating circles, we can hardly doubt that this was the original theory of the ἁρμονία and that Timaeus is following it.

If this is so, an important consequence follows. There is an absolute contradiction between the idea of the ἁρμονία and the theory of the κράτος which Timaeus ascribes to the circle of the Same. On the theory that all the circles rotate in the same sense, their swiftness diminishes, and the pitch of their notes rises in a regular gradation as we pass outward from the moon[1] to the ἀπλανές. But now, suppose we introduce the further complication referred to when the circle of the Same is said to have the κράτος over the circle of the Other. As is more fully explained later on (39 a–b), the astronomical meaning of this is that the E. to W. diurnal motion of the ἀπλανές is communicated to the planetary circles, so that the actual path of a planet is composite. It has its own proper revolution from W. to E. in its own 'period', month, year, or what not, and at the same time is carried round in the opposite direction E. to W. by the diurnal revolution of the whole universe. Neglecting for the moment the further fact that the plane of the Ecliptic is oblique to the plane of the Equator, consider the precise effect of the mere combination of two movements in a contrary sense. If there were no 'prevailing' of the circle of the Same, i. e. if the planetary motions were not composite, the movement of the circle of the Same from E. to W. would explain why the stars return to their places every twenty-four hours, the movements of the divided circle of the Other would explain why the sun and his attendants travel through the Zodiac from W. to E. in periods of various lengths. But it would then be an unsolved problem why the sun and planets rise and set, in fact, why it is not perpetual daylight with us and why we ever *see* the stars at all. What we have to account for is the complex of the following facts: (*a*) that there is the alternation of day and night, (*b*) that the stars appear to return uniformly to the same places every twenty-four hours, (*c*) that the sun and planets behave differently. The sun rises and sets daily (to observers not within the Arctic or Antarctic circle), but he also travels in the course of a year through the Zodiac from W. to E. The consequence is that he does not rise every morning and set every night at the same points. At the spring equinox he rises due E. and sets due W. Then until midsummer he rises every morning a little more N. of E. and sets every evening a little more N. of W. than he did the day before. At midsummer, when he has reached

[1] Or the earth, if the original form of the doctrine is correctly preserved on this point, as I have little doubt that it is, by Alexander (of Aetolia?).

the 'sign' of Cancer, he appears to 'turn back' (τρέπεσθαι) in his advance northwards, and from midsummer to the autumn equinox he rises daily a little less N. of E. and sets a little less N. of W. At the autumn equinox he is again rising and setting due E. and due W. Then until midwinter he rises daily more and more S. of E. and sets more and more S. of W. At midwinter, when he has just reached the sign of Capricorn, he arrests his progress southwards and 'turns back' again. From this time on, he rises daily less and less S. of E. and sets less and less S. of W. until the spring equinox comes round once more. Timaeus explains these 'turnings' (τροπαί) of the sun and the corresponding behaviour of the other 'planets' by giving all the planets a double motion, one, in the Zodiac, which is proper to each planet, and another communicated to the planet by the circle of the Same, which carries the planet round with it from E. to W. while the planet is also executing its 'proper' movement from W. to E. The result of this is that the sun (to confine our attention to him) is carried round daily from E. to W. by the diurnal revolution. But during each day he has also gone a certain part of his yearly journey through the Zodiac from W. to E. The result is that he is not brought back each morning at sunrise to the point where he rose the morning before. There are further complications still to be taken into account, and we shall hear of them a little later on. The first and simplest point to be grasped in trying to understand any astronomical system which puts the earth at or near the centre of a finite universe is that, unless indeed we ascribe an axial rotation or its equivalent to the earth (as we shall see that Timaeus does not), we must *begin* by ascribing this double motion to the sun and each of his satellites. We must think of them as carried round daily by the 'revolution' of the ἀπλανές from E. to W. while they are also travelling more slowly from W. to E. on their own account. The theory of the double motion is at least a very great advance in astronomy upon the earlier theory of motions all in the same sense though with different periods, and it may be worth while to point out exactly why this is so. We shall see the reason if we imagine for a moment that the Zodiac lay along the sidereal equator. If the ecliptic and equator were in the same plane, what would be the 'appearances'? Clearly, we should see the sun rising every morning at exactly the same point, as determined by references to terrestrial objects, i. e. over the brow of the same hill. But the same 'star' would seem to come round to our meridian in a little less than a day, owing to the fact that the sun has gone some way in his annual course from W. to E. during the day. We should, in fact, discover that the 'sidereal day'—the interval between two successive transits of the same star over the meridian—is a little shorter than the 'solar day'. (The approximate length of the 'sidereal' day at present is 23 hrs. 56 min. 4 secs.) If this were the only appearance to be 'saved', the double motion theory and the single motion theory would serve our turn equally well. Instead of giving the sun a proper motion from W. to E. in the year, we might say that it is 'left behind' by the more rapid movement of the ἀπλανές. Here, however, comes in the obliquity of the ecliptic to the equator with its consequences, the annual alternate

advance of the sun to N. and S. It is these facts, in a word the sequence of the 'seasons', which directly suggest as the most natural account of the appearances the view that the sun's own motion is in the sense opposed to that of the 'diurnal revolution'; the double motion theory is a direct consequence of Anaximander's discovery of the obliquity of the ecliptic. This explains why it retains its place as fundamental in all the later theories which assume a stationary earth at 'the centre', like those of Eudoxus, Aristotle, and Ptolemy. In fact, when once the consequences of Anaximander's discovery have been realized, the only alternative to the theory of the double motion is to ascribe one or both of the motions to the earth itself. This reflection may naturally lead us to raise the question of the authorship of the double motion hypothesis. Since it is a consequence of a discovery of Anaximander, it might have been possible to devise it at any time after the discovery had once been made. Anaximander might have originated it himself but for the fact that he accounted for the *οὐρανός* as formed by a sort of eddy in the 'boundless'. Hence it is not at all likely, as has sometimes been supposed, that the whole theory is an invention of Plato and the early Academy. If it had been, we should not expect to find it put into the mouth of Timaeus, who is supposed to be speaking not long after Plato's own birth. Further, we find the theory not only in the *Timaeus* but in the myth of Er at the end of the *Republic*. We are expressly told there (617 a) that there are eight circles of which the inner seven revolve in the sense opposite to that of the whole system (*κυκλεῖσθαι δὲ δὴ στρεφόμενον τὸν ἄτρακτον ὅλον μὲν τὴν αὐτὴν φοράν, ἐν δὲ τῷ ὅλῳ περιφερομένῳ τοὺς μὲν ἐντὸς ἑπτὰ κύκλους τὴν ἐναντίαν τῷ ὅλῳ ἠρέμα περιφέρεσθαι*), exactly the doctrine which Timaeus expresses by saying that the inner circles are 'mastered' or 'controlled' by that of the Same. In both dialogues, it will be noted, no explanation of the reasons for the doctrine are given. It is mentioned in a way which assumes that it will be familiar to the hearers and accepted by them without question. Clearly, then, it is not meant that either Socrates in the *Republic* or Timaeus in our dialogue is propounding a novelty; the assumption is that the double motion is already a well-established doctrine in fifth-century astronomy, and that it is held by eminent Pythagorean astronomers like Timaeus. If we turn to the *Laws* and *Epinomis* we further get absolute proof that Plato himself did not hold the theory, in the form in which it is given in the *Republic* and *Timaeus*. In *Laws* vii. 821 e 1–822 b 1 the Athenian speaker who represents Plato's own views insists on it as a point of fundamental importance that his contemporaries have none of them grasped a truth about the heavenly bodies which it is sacrilege—since these bodies are in a sense 'gods'—to deny. This truth, and he says he has only recently learned it himself (821 e 3 *ἐγὼ τούτων οὔτε νέος οὔτε πάλαι ἀκηκοὼς σφῶν ἂν νῦν οὐκ ἐν πολλῷ χρόνῳ δηλῶσαι δυναίμην*), is that the sun and each of the other so-called 'planets' ('stellae *vagabundae*'), has a single simple circular orbit (822 a 6 *τὴν αὐτὴν γὰρ αὐτῶν ὁδὸν ἕκαστον καὶ οὐ πολλὰς ἀλλὰ μίαν ἀεὶ κύκλῳ διεξέρχεται, φαίνεται δὲ πολλὰς φερόμενον*). Obviously what the Athenian is here denying with all possible emphasis is precisely the very theory of the double motion of the planets taught by Timaeus and by

Socrates in the *Republic*.[1] In the *Epinomis* there is a sentence which makes the bearing of the remark quite clear. We are told there that the seven planetary circles all revolve in one sense, while the eighth, 'which may most properly be called the κόσμος, revolves in the opposite sense, carrying the rest along with it, as those who know but a little of these matters might fancy'.[2] In saying that the ἀπλανές 'carries the others along with it,—as those who know only a little of the subject might fancy', Plato is saying with an urbane irony that it does not really carry the others with it, i. e. he is denying in set words, what he has denied by implication in the *Laws*, the reality of the double motion. He admits that the revolution of the ἀπλανές is in a contrary sense to that of the planets (that is an undeniable 'appearance'), but he denies that this movement is in any way communicated to the circles of the planets themselves. The full consequences of this denial will have to be examined later in connexion with Timaeus's statements about the earth, but its importance should be manifest when we remember that the double motion is fundamental in the astronomy of Plato's eminent associate Eudoxus, and of Aristotle and his friends. It is they rather than Eudoxus himself, who was probably dead when Plato wrote the words, who are really meant by the allusion to persons who 'know only a little' about astronomy. The statement of the *Epinomis* must not be discredited by urging that the dialogue is perhaps spurious. It is at least certain that the *Epinomis*, if not Plato's, is the work of an immediate pupil and thus gives us a contemporary supplement to the *Laws*. Now the text of the *Laws* can only be accounted for reasonably on one supposition, that it is, as Proclus said, 'unrevised'. The disciples who circulated the work had too much respect for the *ipsissima verba* of their deceased master to make grammar of his most tangled sentences, even when this could have been done by such trifling verbal changes as would pretty certainly have been made by the author himself in writing out a 'fair copy'. Men who were so scrupulous about the smallest matters of language would not have taken it on them to append to the *Laws* a supplement in which Plato was contradicted on fundamental points of doctrine.[3] It might be suggested

[1] It is not the Athenian's point that the paths of the planets are not wholly irregular, and that they do not deserve their popular name of 'tramps' or 'vagabonds'. A believer in the double motion may hold, as Timaeus does, that the planets follow some regular law in their movements. The Athenian's point is that a planet's path is a *simple* closed curve (*οὐ πολλὰς ἀλλὰ μίαν ἀεὶ κύκλῳ*), and this, of course, can only be directed against the hypothesis of the double motion.

[2] 987 b 6 *ἕνα δὲ τὸν ὄγδοον χρὴ λέγειν, ὃν μάλιστά τις ἂν κόσμον προσαγορεύοι, ὃς ἐναντίος ἐκείνοις σύμπασιν πορεύεται—ἄγων τοὺς ἄλλους, ὥς γε ἀνθρώποις φαίνοιτ' ἂν ὀλίγα τούτων εἰδόσιν.* Bt. unnecessarily inserts a conjectural ⟨*οὐκ*⟩ before *ἄγων* against all MSS. This makes no difference to the sense, but destroys the urbane 'irony' of Plato's language.

[3] The only alternative to acceptance of the existing text of the *Laws*, with the explanation suggested above for its singularities, is wholesale rewriting, such as has been adopted by Ast and to a lesser degree by Schanz in his edition of Bks. I–VI. This method presupposes a radical corruption of the text older than both all existing MSS. and those of the writers of the early centuries of our era who provide us with numerous *testimonia*. Now what reason is there to assume greater corruption in the *Laws* than in other dialogues of which the text depends on the same sources? In

with more surface plausibility that the *Laws* and *Epinomis* represent a final development in Plato's astronomy which was only made after the circulation of the *Timaeus*. Only, as we have seen in our *Prolegomena*, there is no evidence that the astronomical passages in the *Laws* were really written later than those in the *Timaeus*, and at any rate the two works cannot be separated by any wide interval. If there were such evidence, we should not be entitled to deny that Plato might suddenly modify his opinions, even on fundamental matters, but in the absence of evidence it is reasoning in a circle to argue that the *Laws* passage must be later than the *Timaeus* because it contradicts it, and that because the *Laws* is the later work, Plato must have changed his views *after* writing the *Timaeus*. The more natural inference is that the theory of the double motion is what Plato gives it as being, a fifth-century theory, and that he had never expounded it as his own at all. It may be added that Aristotle, who was wedded to the theory of the double motion in the form given to it by Eudoxus, would have been very unlikely to have kept silence about such a thing as the total reconstruction of Plato's astronomy in the last years of his life, if the reconstruction had ever happened. We may fairly conclude that the theory really was one of those maintained by fifth-century Pythagoreans, and perhaps from the confidence with which Timaeus gives it, that it was the prevalent theory of the school at that time. It thus becomes quite possible that the theory was originated by Pythagoras himself, as Bt. now suggests (*EGPh.*[3] 110). In favour of this view we have the very important fact, mentioned by Bt., that the *Placita* of Aetius trace the theory back as far as the famous Alcmaeon of Crotona, a younger contemporary of Pythagoras who stood in close relations with the Pythagorean society (*EGPh.*[3] 193–6). It is true that the earliest author who expressly ascribes the doctrine to Pythagoras is Theon of Smyrna (ed. Hiller 150. 16), but Theon is here following the learned Peripatetic Adrastus, who was not given to making such assertions at random. In any case, since the doctrine of the double motion follows so naturally from Anaximander's discovery of the obliquity of the ecliptic, and the early Pythagorean cosmology demonstrably starts from Anaximander, it is probable that the theory was originated very early in the history of the school, and we see why it is treated in the *Republic* and *Timaeus* as an accepted view which demands no kind of proof.

But now consider the bearing of the double motion on the 'music of the heavens'. The acceptance of the theory entirely upsets the older views as to the 'swiftness' of the planetary circles. If they are all revolving in the same sense as the outermost circle of the ἀπλανές, Saturn, which most nearly 'keeps up' with the ἀπλανές must be the swiftest, the moon, which 'falls behind' roughly 12° daily, must be the slowest of all the planets. But if the planetary circles are going one way and the ἀπλανές the other, we must describe the appearances quite differently. We must say that the ἀπλανές is passed by the moon in a month, but by Saturn in

particular, why is Paris A, which contains both *Republic* and *Laws*, to be treated as of less value for the one dialogue than for the other? I am not aware that the 'emendators' have ever faced this obvious question.

thirty years. The moon will thus be the swiftest, Saturn the slowest of all the planets. Timaeus himself makes the point at 39 a 4–5 where he says that the circles which go fastest, i.e. have the greatest proper motion from W. to E. in the Zodiac, are believed to be 'caught up by' the slower, whereas the truth is that they 'catch up' the slower (*τὰ τάχιστα περιιόντα ὑπὸ τῶν βραδύτερον ἰόντων ἐφαίνετο καταλαμβάνοντα καταλαμβάνεσθαι.*) As to its proper motion the moon is far the swiftest of them all, but to those who do not recognize that the proper motion is in a sense contrary to the 'diurnal revolution', the moon seems to be lagging behind all the others, though Saturn is really the laggard who comes in last in the race. For precisely the same reasons, the Athenian of the *Laws* complains that the popular ignorance of astronomy leads to the 'blasphemy' of calling the swiftest of the 'gods' the slowest.[1] This reversal of view about the speeds of the planets, however, ought to lead to a serious difficulty. On the theory that the 'notes' of the circles correspond to the speed of their revolutions, if the moon is the slowest planet and Saturn the swiftest, the moon should have the lowest note and Saturn the highest of all the seven, and this seems to be best attested as the original Pythagorean doctrine. But the theory of the double motion leads to the opposite consequence that the moon has the highest and Saturn the lowest note. On either theory the *ἀπλανές*, which was supposed to revolve once in twenty-four hours, is far the swiftest of all the circles and therefore has far the highest note. It follows that when you come to adapt your theory of the *ἁρμονία* to the new view of the sense of the planetary motions, the lowest and the highest tones of the *ἁρμονία* must be next one another. Bt. has called this an impossible arrangement, and so it is. But, since the 'velocities' of the circles were estimated simply by the length of time they take to revolve, it is the arrangement which is forced on any one who accepts the principle of the contrariety of sense between the circles of the planets and the *ἀπλανές*, and the Pythagoreans, if they did not see this, were just shutting their eyes to a contradiction. The only ways to get out of the difficulty would be to cut the *ἀπλανές* altogether out of the scheme of the *ἁρμονία* or else to give it a very slow movement, and to account for the alternation of day and night and the uniform recurrence of transits of stars by some other hypothesis than that of a 'diurnal revolution'. (In a later note I shall try to show that this is what Plato himself did.) If we realize that this contradiction is an inevitable consequence of the combination of the two doctrines that the planets revolve counter to the *ἀπλανές* and that the revolution of the *ἀπλανές* has a period of twenty-four hours (as Timaeus expressly asserts, at 39 c 1), and also remember that the evidence seems to show that the

[1] *Laws* 822 a 9 ff. *τὸ δὲ τάχιστον αὐτῶν ὂν βραδύτατον οὐκ ὀρθῶς αὖ δοξάζεται, τὸ δ' ἐναντίον ἐναντίως. . . . νῦν δὲ δὴ περὶ θεοὺς τὰ αὐτὰ ταῦτα ἐξαμαρτανόντων ἡμῶν, ἆρ' οὐκ οἰόμεθα (δ) γελοῖόν τε καὶ οὐκ ὀρθὸν ἐκεῖ* (if we were judging a horse-race) *γιγνόμενον ἦν ἂν τότε, νῦν ἐνταυθοῖ καὶ ἐν τούτοισι γίγνεσθαι γελοῖον μὲν οὐδαμῶς, οὐ μὴν οὐδὲ θεοφιλές γε, ψευδῆ φήμην ἡμῶν κατὰ θεῶν ὑμνούντων.* The Athenian does not say which is the 'swiftest' of the planets, but since the *Epinomis* insists on the contrariety of sense between the planetary movements and the diurnal revolution, he presumably agrees with Timaeus on this point. The view that the moon is the 'slowest' of the planets is Dante's. Cf. *Paradiso* iii. 51 Beata sono in la spera più tarda.

original theory assigned the lowest note to the moon, we may be tempted to conjecture that the doctrine of the ἁρμονία was originally worked out on the assumption that all the circles revolve in the same sense, and consequently that the theory of the double motion of the planets may, after all, not be due to Pythagoras personally, or at least that he did not teach it until he had already laid down a doctrine of the 'music' of the heavenly bodies with which the double motion is really inconsistent.[1]

36 d 5–6. τάχει δὲ . . . ἀνομοίως. Grammatically the τρεῖς and τέτταρας are in 'partitive apposition' with τοὺς κύκλους, so that the meaning is 'he made the circles revolve in opposite senses, three of them with the same speed, the other four unequal in speed to one another and to the three'. There is a certain want of strict logic in the sentence, since the statement requires us to count in the ἀπλανές in order to explain the κατὰ τἀναντία, whereas in the account of the τάχη we have to think only of the seven circles of the planets. The meaning is simply that three of the planets have the same period. We learn later that these three are the Sun, Venus, Mercury. There can be no question of any of the seven *planetary* circles revolving in a sense opposite to the rest, since we have already been told that the whole of the circle of the Other revolves ἐπ' ἀριστερά. The way in which the circle of the Same is counted in in the first half of the statement but left out in the second, though illogical, is natural enough in conversation, and Plato has not wholly forgotten that Timaeus is not delivering a formal lecture. We see from Proclus (ed. Diehl, ii. 264),

[1] It is a good illustration of the way in which hopelessly incompatible positions can continue to be maintained simultaneously that Macrobius, who is quite alive to the distinction, of which Timaeus takes no account, between the period of a revolution and its velocity, asserts vehemently that the *velocities* of all the *stellae* are equal, ('constat enim nullam inter eas celerius tardiusve procedere', *in Somn. Scip.* i. 21. 6. The *stellae* meant, as the context shows, are the planets.) Macrobius does not invent these things for himself, and we may safely assume that he is repeating a view which he had found among the *Platonici*. How it is to be reconciled with the statement, also accepted by him, that the Sun, Venus, Mercury all have the same period, though the radii of their orbits are different, he does not trouble to explain. There is a further difficulty about these three planets. If they have the same τάχος they should give out the same note, but in that case the complete διὰ πασῶν is not to be got from the eight circles. You could escape from the difficulty if you said that just because the three planets have the same period but different *radii vectores*, they cannot have the same velocity. But to say this you must be clear on the distinction between velocity and period. Macrobius, who knew the distinction, blunders in a different way. He wants to get the seven notes of the heptachord out of the eight circles, and therefore (*op. cit.* ii. 4. 4) assumes that Venus and Mercury give the same note. This means, in the first place, forgetting his own distinction between velocity and period, and, in the second, forgetting also that by parity of reasoning the sun should have the same note as these two planets, so that you would get in all only six notes. (He has forgotten that the original view was that the ἀπλανές completes the διὰ πασῶν.) I do not discuss the attempts which have been made to work out a scale *for Timaeus* which shall give exactly an octave. That the original view was that the heavenly scale is an exact διὰ πασῶν seems certain, but it is not at all clear to me that *Timaeus* does not rather mean to make the compass, as we should expect, that of the much greater ἁρμονία of 35–36 b. Even in the myth of Er (*Rep.* 617 b 5), though we are told that the ἁρμονία has eight notes, Socrates abstains from saying anything about its compass. We must remember that we do not know what Philolaus taught on the point, and that is probably what we ought to know before we can be sure of the meaning of the *Republic* and *Timaeus*.

that a number of ancient expositors assumed that what Timaeus means is that the circles *of the planets* in some sense or other revolve κατὰ τἀναντία ἀλλήλοις. But to explain how this can be they had to take the words in a highly unnatural way. Some of them supposed that Timaeus meant that the sun and moon revolve in their 'epicycles' in a sense opposed to the revolution of their 'principal' circles, whereas the 'other five' have not this peculiarity. To this it is enough to reply with Proclus, that Plato never refers anywhere in his writings to 'epicycles and eccentrics'. (The whole machinery of epicycles and eccentrics was invented in Alexandrian times because the most elaborate attempt to account for 'appearances' by combinations of concentric revolutions, that of Eudoxus, even with the additional complications introduced by Callippus and Aristotle, proved incapable of 'saving' *all* the 'appearances'.) Others suggested that the 'opposition' meant may be that Saturn, Jupiter, and Mars (the extra-solar planets) always reappear after conjunction with the sun as 'morning stars' (τὰς πρώτας φάσεις μετὰ τὰς πρὸς τὸν Ἥλιον συνόδους ἑῴας ποιοῦνται) because they traverse the Zodiac 'more slowly than the sun', the moon always reappears after conjunction (new moon) in the evening, Venus and Mercury (the intra-solar planets) reappear sometimes as 'morning' sometimes as 'evening' stars. But as Proclus properly observes, this distinction, is irrelevant to the 'circles in the soul'. It could only be mentioned, if at all, when we come to the creation of the planetary *bodies*. The same remark applies equally to the other interpretations briefly alluded to by Proclus, which make the opposition refer to such 'appearances' as 'station' and 'retrogradation'. From Proclus's remark about the great variety of these explanations it is clear that none of them rested on any authoritative tradition. Chalcidius (*Comment.* § 97, ed. Wrobel, pp. 167–8) says that 'many' (*plerique*) take the meaning to be that the planets revolve in the opposite sense to the ἀπλανές, but mentions the other views rightly set aside by Proclus,[1] apparently without seeing their impossibility. (His whole account of the astronomy of the dialogue is vitiated by an attempt to read the epicycles of Hipparchus and Ptolemy into Plato.)

36 d 8—37 a 2. ἐπεὶ δὲ κατὰ νοῦν . . . γεννηθέντων. The ψυχή of the world now being completely constructed, the Demiurge set to work upon its body, which he placed 'centre to centre' within its soul; the soul 'revolving within itself' began an endless life of rationality. The meaning here overflows the symbolism, with the result that the picture becomes incoherent if we try to press the details. The complete domination of the cosmic soul over 'its' body (that is the ubiquity of law and rational purpose at all times and all places) is expressed by saying that the soul is everywhere inwoven into the texture of the body (πάντῃ διαπλακεῖσα), from the 'centre' to the 'outmost heaven' (τὸν ἔσχατον

[1] As Martin observes, the mistake appears in Cicero's version, which runs 'interiorem autem cum in sex partes divisisset, septem orbes dispares duplo et triplo intervallo moveri iussit, contrariis *inter se cursibus*', which can only mean that the 'opposition' is between the senses of revolution of the seven planetary circles. It does not follow that Cicero can be quoted as an authority in favour of the view that Timaeus really intends to give certain planets a movement contrary to the sense of the others. He is more probably attempting *verbum reddere verbo*.

οὐρανόν), and wrapped round it 'outside' (ἔξωθεν). The imagery will not really fit the picture of the two 'circles' or 'hoops' into which God shaped the ψυχή, but that picture has served its immediate object, and it would be pedantic to object to its replacement by another. So too, if we tried to take the imagery *au pied de la lettre*, we should have to suppose that the ψυχή was already a ψυχή *before* its body existed, a ψυχή which was not the ψυχή of anything, and yet that it only *began* (ἤρξατο) to live when God had conjoined it with its later-formed body (and therefore was, till that time, a ψυχή and yet not alive). These contradictions ought to save us from understanding the creation of the ψυχή as a beginning in time.

36 d 8. κατὰ νοῦν, simply, in the usual sense of the phrase, 'to his mind', 'as he intended'. A.-H.'s discovery of a double meaning is an unfortunate fancy.

36 e 2. πρὸς τὸν ἔσχατον οὐρανόν. This use of οὐρανός to denote not the whole contents of a 'stellar system' but its outermost circle or surface appears to be specifically Pythagorean. We know that οὐρανός and Ὄλυμπος or ἔσχατος Ὄλυμπος were names given by the school to the ἀπλανές (R. P. 81), and the *Epinomis* is borrowing their language when it speaks (987 b), of the 'eighth circle' as that which may in a special sense (μάλιστα) be called κόσμος. Aristotle (*de Caelo* A. 278^{b} 11 ff.) distinguishes three senses of the word οὐρανός, putting this old Pythagorean sense first. The word, he says, means (1) the substance (οὐσία) of the outmost 'circuit' (περιφορά) of the universe, (2) the body which is continuous with the outermost circuit, the body within which are the sun and moon and 'certain stars' (i. e. the planets), in fact 'heaven' as opposed to 'earth', (3) the body which is enclosed by the outermost circuit (the whole physical universe, including earth as well as heaven).[1]

36 e 4. ἀπαύστου καὶ ἔμφρονος βίου. The ἀπαύστον is strictly in keeping with the teaching of the *Phaedrus* and *Laws* about the ψυχή, but it should be noted that it is quite inconsistent with the doctrine of alternate periods of γένεσις and φθορά in the life of the οὐρανός such as those described in the myth of the *Politicus*. According to the myth, the transition from the one half of the whole cycle to the other is marked by a sudden reversal of the great cosmic motions; the sun, after rising for ages in the east, begins to rise in the west, and so on. (*Politicus* 269 a.) The *Timaeus* knows nothing of such reversals, and the conjunction of ἀπαύστου with ἔμφρονος shows that there is no room in the doctrine it expounds for the alternation spoken of in the *Politicus*, of an age in which the course of the world is directed by God with an age when it is left to drift at the mercy of εἱμαρμένη τε καὶ σύμφυτος ἐπιθυμία (*Polit.* 272 e 6) until God reassumes the 'helm' just in time to prevent a cosmic shipwreck. This is not the kind of existence Timaeus contemplates for his εὐδαίμων θεός. It is true that the *Politicus* myth shows

[1] *loc. cit.* 278^{b} 11 ἕνα μὲν οὖν τρόπον οὐρανὸν λέγομεν τὴν οὐσίαν τὴν τῆς ἐσχάτης τοῦ παντὸς περιφορᾶς, ἢ σῶμα φυσικὸν τὸ ἐν τῇ ἐσχάτῃ περιφορᾷ τοῦ παντός . . . ἄλλον δ' αὖ τρόπον τὸ συνεχὲς σῶμα τῇ ἐσχάτῃ περιφορᾷ τοῦ παντός, ἐν ᾧ σελήνη καὶ ἥλιος καὶ ἔνια τῶν ἄστρων. . . . ἔτι δ' ἄλλως λέγομεν οὐρανὸν τὸ περιεχόμενον σῶμα ὑπὸ τῆς ἐσχάτης περιφορᾶς· τὸ γὰρ ὅλον καὶ τὸ πᾶν εἰώθαμεν λέγειν οὐρανόν.

traces of Pythagorean influence in its very imagery; the 'world-ship' itself is a Pythagorean fancy, as is shown by the curious fact that the dodecahedron was called by the Pythagoreans the 'hull' of the vessel, and the 'central fire' by those of them who believed in it, the 'keel' (*τροπίς*) (see *EGPh.*[3] 294 *n* 1, 2). Some Pythagoreans also believed, like the Stoics after them, and Nietzsche in modern times, in the exact recurrence of all the events of the world's history in cycles, as is shown by a curious fragment of Eudemus.[1] But all these ideas are quite at variance with the express statements of Timaeus, and we have no right to foist them on him. There is, indeed, a certain period in the history of the world to which we shall find Timaeus ascribing importance, the *τελεὸς ἐνιαυτός*, but there is no reason to suppose that he means the completion of this period to be marked by any cosmic catastrophe.

36 e 6. αὐτὴ δὲ ἀόρατος μὲν κτλ. Strictly we should expect *αὐτός* (sc. *ὁ οὐρανός*) but the pronoun which is subject of the 'copulative' verb is, as often both in Greek and in Latin, made to 'agree' in gender with the 'complement'. The construction is exactly like that of the stock example of the Latin grammars, 'Thebae quod caput Boeotiae est'. As *our* *ψυχή* is constantly said by Plato to be most truly ourself, so the *ψυχή* of the *οὐρανός* is said *to be* the *οὐρανός*. The visible 'frame of things' is not the *οὐρανός* but only the body the soul of the *οὐρανός* 'uses'.

37 a 1. τῶν νοητῶν ἀεί τε ὄντων. The genitive is partitive and depends on *τοῦ ἀρίστου*. It is a mistake to attempt to get some kind of modern 'idealism' out of this simple phrase. All that is meant is that though we cannot see God we can think of Him. It is possible, as Descartes asserted and Hobbes denied, to have an 'idea of God', and Plato, for his own part, believed, as Descartes did, that he could prove the existence of God. Cf. for the thought the lines of Timaeus's contemporary Empedocles Fr. 133–4 *οὐκ ἔστιν πελάσασθαι ἐν ὀφθαλμοῖσιν ἐφικτὸν | ἠμετέροις ἢ χερσὶ λαβεῖν, ἥπερ τε μεγίστη | πειθοῦς ἀνθρώποισιν ἁμαξιτὸς εἰς φρένα πίπτει | . . . ἀλλὰ φρὴν ἱερὴ καὶ ἀθέσφατος ἔπλετο μοῦνον | φροντίσι κόσμον ἅπαντα καταΐσσουσα θοῇσιν* (R. P. 180) and the echo of them at *Phaedrus* 246 c 7 *πλάττομεν οὔτε ἰδόντες οὔτε ἱκανῶς νοήσαντες θεόν, ἀθάνατόν τι ζῷον, ἔχον μὲν ψυχήν, ἔχον δὲ σῶμα, τὸν ἀεὶ δὲ χρόνον ταῦτα συμπεφυκότα.* Both passages, like that in the text, are protests against the traditional Greek conception of a god as just a being with an immortal *body*.

37 a 2–c 5. ἅτε οὖν . . . τἀληθὲς ἐρεῖ. It follows from the admixture of the constituents of the *ψυχή*, that *ψυχή* is constantly 'discoursing', enunciating propositions to herself, about both intelligibles and sensibles. When the circles in the soul perform their work duly and properly, if the object of her discourse is the intelligible, we have 'understanding' (*νοῦς*) and science (*ἐπιστήμη*). When the object is something sensible we have true and assured judgement (*δόξαι*) or belief (*πίστεις*). And nothing but a *ψυχή* is capable of either.

[1] Eudemus *ap.* Simplic. *in Physica* 732. 30 (ed. Diels) = R. P. 84 *εἰ δέ τις πιστεύσειε τοῖς Πυθαγορείοις* [the word, by the way, is neuter, 'the Pythagorean fancies'] *ὥστε πάλιν τὰ αὐτὰ ἀριθμῷ, κἀγὼ μυθολογήσω τὸ ῥαβδίον ἔχων ὑμῖν καθημένοις οὕτω, καὶ τὰ ἄλλα πάντα ὁμοίως ἕξει, καὶ τὸν χρόνον εὔλογόν ἐστι τὸν αὐτὸν εἶναι.* That is, *if* all events recur, the moments at which they occur must recur too, and the numerically *same* moment is endlessly repeated.

37 a 2–4. *ἐκ τῆς ταὐτοῦ . . . μοιρῶν.* Note that this allusion to the language of 35 a–b of itself is enough to show that the *ἀμέριστον* and *μεριστόν* and the *ταὐτόν* and *θάτερον* of that passage are one and the same pair of 'opposites'. The thought is simply that 'Like is known by like'. Since the soul has both *ταὐτόν* and *θάτερον* in her own structure and 'revolves upon herself, she is alive to the presence of *οὐσία σκεδαστή* (= *τὸ μεριστόν*) and of *οὐσία ἀμέριστος* outside herself also. And since she was constructed *ἀνὰ λόγον* (in accord with a rational formula), she is moved by contact with what is without to rational or intelligible discourse. The presence of the eternal and of the temporal in her own nature renders her sensitive to the eternal and to the transitory without. And because she has an organized structure of her own, her response to the 'external' object takes the form of that attempt to organize or articulate her knowledge into a system which we call 'science'. If one may use the terminology of Professor Alexander's *Space, Time and Deity* one may say, that it is because the mind *has* the same 'categorial' features as all other things that the mind discovers those categorial features in the objects of her contemplation. On the combination *καὶ . . . τε* with the sense *praetereaque* see Kühner-Gerth ii. 2, § 522 (p. 251 n. 2). The emphasis falls on the second clause. 'Being constructed in the fashion described, and moreover, revolving upon herself.' Martin's version 'étant d'ailleurs divisée et unie avec proportion, et tournant toujours sur elle-même' seems to misplace the emphasis. A.-H. neglects it.

37 a 5–b 3. *ὅταν οὐσίαν . . . ἔχοντα ἀεί.* The construction is carefully explained by Stallbaum *ad loc.* When the soul apprehends a thing, whether 'divisible' or 'indivisible', then, moving throughout her whole being, she declares, *πρὸς ὅτι μάλιστα καὶ ὅπῃ καὶ ὅπως καὶ ὁπότε τοῦτο ὅτῳ ἄν τι ταὐτὸν ᾖ καὶ ὅτου ἂν ἕτερον, συμβαίνει ἕκαστον εἶναι καὶ πάσχειν πρὸς ἕκαστον κατὰ τὰ γιγνόμενά τε καὶ πρὸς τὰ κατὰ ταὐτὰ ἔχοντα ἀεί*, 'with what thing precisely (*μάλιστα*), in what manner, how and when that with which anything is identical or different is and is predicated to be (*πάσχει*) each of these (i.e. identical or different) relatively to the various objects both in the sphere of becoming and in that of eternally self-same being'. In a word, the soul makes all sorts of judgements about the identity or difference of *A* and *B* in all sorts of respects, both when *A* and *B* are 'intelligibles' and when they are 'sensibles'. The sentence only presents difficulties because of the redundancy of the phraseology. *ἕκαστα* in b 2 means simply each of the characters already mentioned, i.e. identical and different, and *συμβαίνει ἕκαστα εἶναι καὶ πάσχειν* is a mere periphrasis for *ἐστὶ καὶ πάσχει ἕκαστα.* The *εἶναι* refers more particularly to judgements that a thing is identical with or different from a second thing, the *πάσχειν* to judgements about the *ὅπῃ καὶ ὅπως καὶ ὁπότε*, the 'how and when' of the identity or difference. For *πάσχειν* in the sense 'to have a certain predicate', cf. such passages as *Parm.* 139 e 7 *τὸ ταὐτόν που πεπονθὸς ὅμοιον*; 'and, of course, things which have the same predicate are alike', *ib.* 140 a 1 *εἴ τι πέπονθε χωρὶς τοῦ ἓν εἶναι τὸ ἕν, πλείω ἂν εἴναι πεπόνθοι ἢ ἕν*, 'if the one has any other predicate than unity, we can predicate of it that it is more than one', *Euthyphro* 8 d 8 *οὐκοῦν αὐτά γε ταῦτα καὶ οἱ θεοὶ πεπόνθασιν*, 'and we can predicate the same even of the gods' &c.

A.-H. (and apparently Martin) strangely suppose the words from ὅτῳ τ' ἄν to συμβαίνει to form a single dependent interrogative clause, in defiance of grammar.

37 b 3–c 3. λόγος δὲ . . . ἀποτελεῖται. As for the grammar and verbal sense, the subject of the verbs γίγνηται (b 6) and ᾖ (c 1) is λόγος, *not*, as A.-H. makes it in his translation, ψυχή. The general meaning thus is that the λόγος or discourse of the soul is sometimes concerned with what is perceptible to sense, sometimes with what is not; in both cases it is possible to have a true 'discourse'. In the former case this true discourse amounts to 'belief', 'conviction', 'true judgement', in the latter to νοῦς and science. Next, the qualification ἐν τῷ κινουμένῳ ὑφ' αὑτοῦ φερόμενος ἄνευ φθόγγου καὶ ἠχῆς is added to λόγος to show that the discourse meant is not actual speech of one man to another, but 'thinking', the 'conversation of the soul with itself'. τὸ κινούμενον ὑφ' αὑτοῦ is a periphrasis for ψυχή, the Platonic definition of ψυχή being that it is the 'movement which moves itself' (*Laws* 896 a 1). Timaeus made no use of this definition in his description of the making of the cosmic ψυχή, but the present passage shows that he regards spontaneous motion as at any rate a *proprium* of ψυχή so that every ψυχή is 'self-moving' and everything self-moving is a ψυχή. φερόμενος is an appropriate word because κίνησις is a character of ψυχαί no less than of bodies, and the most primitive κινήσεις of all, on which all others depend, are precisely the 'motions' of soul. The conception of thinking as 'the discourse of the soul with itself', which recurs more than once in Plato is suggested by the method, originated by Zeno of Elea and adopted by Socrates, of eliciting scientific truth by question and answer (the 'dialectical' or 'conversational' method). When we think out a result for ourselves, the ψυχή plays both parts in the discussion. It puts a question to itself and answers its own question. We ask ourselves whether such and such a 'postulate' (ὑπόθεσις) will 'save' or do justice to the 'appearances' to be accounted for. We ourselves then provide an answer; e.g. we answer our own question by saying that the ὑπόθεσις will not 'save' such and such of the appearances, or perhaps that it is at present doubtful, without closer examination, whether it will 'save' them. The Greeks have sometimes been foolishly derided for the belief that the way to find out the truth about a subject is to 'sit down and talk about it', but the method is that of all serious scientific research. Before a man puts forward a statement as the true theory of some appearances, it is his business to have done what, in actual conversation, a capable critic would do for him, to ask for any objections to his theory and to see how far they can really be sustained. The framing and rejection of 'tentative hypotheses' which are found not to account for all the facts, the removal of objections by showing that facts which seemed at first to contradict the hypothesis are really in accord with it, the devising of 'verificatory' observations and experiments are all part of the process of the mind's 'conversation with itself'. It is just the greatest men of science who do not need to have the objections and difficulties raised by their hypotheses pointed out on the platform or in print by their rivals, because they have already thought of them for themselves. The fullest account of the soul's

'conversation with herself' in Plato is that at *Philebus* 38 c–e, where the example chosen is that of a man trying to discover the real character of a thing seen at a distance. He asks himself, for want of a companion with whom he might put the matter into words, 'what is that which appears to be standing by yonder rock, under a tree?' He answers himself, it may be, that 'it is a man', or that 'it is an effigy made by shepherds'. His belief, in either case, comes as the answer to a question which he has put to himself; the process of reaching the belief has been a sort of internal 'talk with himself'. So at *Theaetetus* 190 a thinking is described as a dialogue of the soul with itself (*τοῦτο γάρ μοι ἐνδάλλεται διανοουμένῃ, οὐκ ἄλλο τι ἢ διαλέγεσθαι, αὐτὴ ἑαυτὴν ἐρωτῶσα καὶ ἀποκρινομένη, καὶ φάσκουσα καὶ οὐ φάσκουσα. . . . ὥστ' ἔγωγε τὸ δοξάζειν λέγειν καλῶ καὶ τὴν δόξαν λόγον εἰρημένον, οὐ μέντοι πρὸς ἄλλον οὐδὲ φωνῇ ἀλλὰ σιγῇ πρὸς αὑτόν*). It seems clear that these Platonic passages are the ultimate source of the famous Stoic distinction between *λόγος προφορικός* and *λόγος ἐνδιάθετος* (for which see R. P. 483 a and 611 a) and so, I suppose, of the modern antithesis between the 'transitive' and the 'immanent'. As to the early history of the 'dialectic' method, the examination of a tenet by rigid questioning with a view to discovering whether you can hold it without contradicting some proposition you have already admitted, it seems clear that the first example of the method in literature was Zeno's famous work against the (Pythagorean) opponents of Parmenides. Plato has made Zeno himself give a no doubt faithful account of his 'dialectic' at *Parm.* 128 c–d. We are there told that the object of the work was to silence the opponents of the Monism of Parmenides who tried to refute him by a proof that Monism leads to paradoxes. Zeno replied that their own assumption 'that things are many', that there is more than one 'real being', led to paradoxes as bad or worse (*ἀντιλέγει δὴ οὖν τοῦτο τὸ γράμμα πρὸς τοὺς τὰ πολλὰ λέγοντας, καὶ ἀνταποδίδωσι ταὐτὰ καὶ πλείω, τοῦτο βουλόμενον δηλοῦν, ὡς ἔτι γελοιότερα πάσχοι ἂν αὐτῶν ἡ ὑπόθεσις, εἰ πολλά ἐστιν, ἢ ἡ τοῦ ἓν εἶναι, εἴ τις ἱκανῶς ἐπεξίοι*). From the fragments and summaries of Zeno's reasoning preserved by later writers, as well as from Plato's imitation of it in the second part of his *Parmenides*, we see that Zeno's special trick of fence was to prove that Pluralism leads to conclusions which contradict not only 'common-sense' but one another. That Socrates really was indebted to Zeno for his own use of the method (carefully described at *Phaedo* 100–101), is directly suggested by the way in which the *Parmenides* represents him as introduced to the use of the method in his early life by Parmenides and Zeno (*Parm.* 135 c 8 *πρῳ γάρ, εἰπεῖν, πρὶν γυμνασθῆναι, ὦ Σώκρατες, ὁρίζεσθαι ἐπιχειρεῖς καλόν τέ τι καὶ δίκαιον καὶ ἀγαθὸν καὶ ἓν ἕκαστον τῶν εἰδῶν. . . . τίς οὖν ὁ τρόπος, φάναι, ὦ Παρμενίδη, τῆς γυμνασίας; οὗτος, εἶπεν, ὅνπερ ἤκουσας Ζήνωνος*).[1] Socrates makes it afterwards his own throughout life, and it is

[1] Note what the *Parmenides* ascribes to Socrates and what it does not. Parmenides and Zeno are represented as hearing from him as his *own* special doctrine, not indeed that there are such things as *Forms*, but that the Forms are Forms *of* sensible things and that sensible things 'participate' in them (129 a–130 a), and in particular that there are Forms of *δίκαιον* and *καλόν* and *ἀγαθόν* (130 b, 135 c). This covers exactly the ground of what Socrates calls his own 'amateurish' doctrine in the *Phaedo* (100 d). The dialectical *method*, on the other hand, Plato represents as *taught* to Socrates by the older men.

equally Plato's method, and that is why Socrates and Plato are as truly 'critical' philosophers as Kant, though their results are so different from his. With both of them the mark of the true philosopher is that he is always ready and competent to 'give and receive an account' (*διδόναι καὶ δέχεσθαι λόγον*) of any theory propounded for acceptance. In the employment of the method of question and answer, it is the 'answerer' who *gives* an account of the theory he is defending, the 'questioner' who *receives* and examines the account. (I suggest that the metaphor of this familiar Platonic phrase is a commercial one. The 'respondent' exhibits his *λόγοι*, 'accounts' or 'balance-sheets' to the 'questioner', who audits them and finds them in order or out of order as the case may be.) The reason why in the *Republic* the *μέγιστον μάθημα* is named Dialectic is just that its business is to make a critical examination of the principles which all the other sciences have been content to assume. Zeno's way of using the method also explains the special senses put on the word by both Aristotle and Kant. With Aristotle 'dialectic', as opposed to science, means reasoning from premisses which are not known to be truths, but are merely *ἔνδοξα*, 'plausible views'. A view is 'plausible' if it is very widely held, or again if it is held by eminent specialists, or if it is that of the person against whom you are disputing; *he* cannot regard his own views as anything but *ἔνδοξα*, since he has conceded their truth. This exactly hits off the peculiarity of Zeno's methods. So it is the historical accident that Zeno employed the premisses of his opponents to prove pairs of contradictory conclusions which accounts for Kant's choice of the name *Transcendental Dialectic* for the division of the *Critique of Pure Reason* which discusses the contradictions into which, as Kant holds, 'pure Reason' inevitably leads us when it tries to work on material not supplied by 'possible experience'.

37 b 7. **εἰς πᾶσαν αὐτοῦ τὴν ψυχήν.** What does *αὐτοῦ* mean here? The MSS. offer no other reading and their text is confirmed by Proclus (Diehl ii. 311) who raises the question, and remarks that Porphyry had already called attention to the ambiguousness of the word. It has been proposed to alter it to *αὐτό* (Dammann approved by Stallbaum) or *αὐτά* (A.-H.) so as to get a parallel with the *αὐτὰ μηνύσῃ* of c 2 below. The meaning then would be 'announces it', 'proclaims it', viz. the object apprehended. But the argument alleged in favour of the change seems to me to tell against it. Plato is aiming throughout the passage at verbal variety (*διαγγείλῃ . . . μηνύσῃ—ὀρθὸς ἰὼν . . . εὔτροχος ὤν*), and the exact correspondence produced by the change is thus a reason for avoiding it, if we can. Proclus took it to mean *τοῦ λόγου*, 'makes announcement to the whole soul to which the *λόγος* or discourse belongs' (*μᾶλλον δὲ ὡς πρὸς τὸν λόγον ἀποδοτέον· δόξαι γὰρ αὐτοῦ γίγνονται τοῦ λόγου καὶ πίστεις, τοῦ ὀρθοῦ κύκλου τὰ αἰσθητὰ διαγγέλλοντος, op. cit.*, ii. 311). Martin renders 'dans toute l'étendue de l'âme à laquelle il appartient', but takes the *αὐτοῦ* to mean not the *λόγος* but the 'circle of the Other', 'the whole soul to which this circle belongs' (*Études sur le Timée*, ii. 49).[1] This is,

[1] To be quite exact M. should have understood *αὐτοῦ* to refer to *θάτερον* rather than to *ὁ τοῦ θατέρου κύκλος*. If the latter is meant we ought at least to have *αὐτοῦ*. But this reflection is really fatal to M.'s view. For though the *κύκλος τοῦ θατέρου* belongs specifically to the *ψυχή*, *θάτερον* itself does not; it is a factor in everything created.

perhaps, an improvement on Proclus. But I find it hard to think that Plato could have spoken either of the ψυχή of a λόγος, in the sense of the ψυχή which carries on the λόγος, or of the ψυχή of one of the circles in the ψυχή. As I can see no sufficient evidence that there is anything wrong with the MSS. text, I would suggest that αὐτοῦ is a possessive genitive, 'its soul', and that we are to understand from the context generally that the 'it', the possessor of the ψυχή in question—the only ψυχή which has so far been created—is the οὐρανός. Not very dissimilar is the use of αὐτό in the well-known passage about Sophocles the poet, *Rep.* 329 c 2 "εὐφήμει," ἔφη, "ὦ ἄνθρωπε· ἀσμενέστατα μέντοι αὐτὸ ἀπέφυγον" κτλ. where αὐτό 'the thing you speak of' has really no actual noun or nominal phrase to which it refers. Cf. again *Laws* x. 888 b 4 πρῶτον δὲ περὶ αὐτῶν ἓν τι μέγα σοι μηνύων οὐκ ἄν ποτε φανείην ψευδής, where αὐτῶν refers not to τοὺς θεούς the substantive which has occurred just before, but to the ὧν νῦν δοξάζεις of b 1, three lines above; *ib.* v. 727 a 4 ὁ δ' ἡγούμενος ἢ τισι λύγοις ἢ δώροις αὐτὴν αὔξειν ἢ τισιν ὑπείξεσιν, where αὐτήν = τὴν αὐτοῦ ψυχήν, though this was last mentioned in the preceding sentence four lines before. Not very different is Laws v. 729 b 5 ὁ δ' ἔμφρων νομοθέτης τοῖς πρεσβυτέροις ἂν μᾶλλον παρακελεύοιτο αἰσχύνεσθαι τοὺς νέους, καὶ πάντων μάλιστα εὐλαβεῖσθαι μή ποτέ τις αὐτὸν ἴδῃ τῶν νέων ἢ καὶ ἐπακούσῃ δρῶντα ἢ λέγοντά τι τῶν αἰσχρῶν, where αὐτόν = 'a man himself'.

37 c 1. περὶ τὸ λογιστικόν. The clause answers to the περὶ τὸ αἰσθητόν of b 6. Hence λογιστικόν cannot have an active meaning such as A.-H. wishes to give it. As C. W. says, commenting on the passage, λογιστικός means by etymology simply 'connected with λογισμός'. There is nothing in the *form* of the adjective in -ικός to confine it to an active sense. Similarly Aristotle sometimes uses αἰσθητικός in the most general way to mean 'connected with sensation', though more commonly the word means 'percipient', 'sensitive', as contrasted with αἰσθητόν, 'sensible', 'perceptible'. C. W. (p. 115) cites the Aristotelian phrase φαντασία αἰσθητική. Cf. *de Anima* Γ. 433^{b} 29 φαντασία δὲ πᾶσα ἡ λογιστικὴ ἢ αἰσθητική, 434^{a} 5 ἡ μὲν οὖν αἰσθητικὴ φαντασία, ὥσπερ εἴρηται, καὶ ἐν τοῖς ἄλλοις ζῴοις ὑπάρχει, ἡ δὲ βουλευτικὴ ἐν τοῖς λογιστικοῖς. It seems clear that φαντασία αἰσθητική can only mean 'sensuous imagination' or 'sensuous imaging', imagination which is concerned with *sensibilia*, not 'sensitive' imagination, imagination which is sensitive, a phrase which, indeed, would have no satisfactory meaning. In the *Timaeus* itself we have at 61 d 1 the still more remarkable expression τὰ παθήματα ὅσα αἰσθητικά in the sense of 'sensible affections', 'qualities apprehended through sense'. And it would not be hard to produce other instances of adjectival forms in -ικός with a similar neutral sense; πλαστικός, 'fit for moulding', occurs in our dialogue. Aristotle's πρακτικὴ ἐπιστήμη and πρακτικὴ φιλοσοφία do not mean science or philosophy which acts, but science or philosophy which is concerned with action or studies action, λογιστική itself, when used as the name of a study, means not so much a study which computes, but a study which is concerned with computations. In point of fact, the main reason why Plato does not say περὶ τὸ λογιστόν here, as he says περὶ τὸ αἰσθητόν, seems to be simply that there was no word λογιστόν in use; at least we have no instance of the word, and

we might fairly have expected to have instances somewhere in philosophical literature if there had been such a word. Perhaps, however, if there had been, Plato would none the less have said λογιστικόν here, expressly for the sake of variety.[1]

37 c 2. νοῦς ἐπιστήμη τε ἐξ ἀνάγκης ἀποτελεῖται. We should probably not attempt to find here any distinction between νοῦς and ἐπιστήμη analogous to the distinction drawn in *Rep.* vii. 511 d 2 between νοήσις or νοῦς, which apprehends the whole body of truth in its dependence upon absolute and ultimate principles, and διάνοια, which is content to confine itself to deductions from 'postulates' (ὑποθέσεις) themselves submitted to no critical examination. Still less should we credit Timaeus with Aristotle's standing distinction between νοῦς as the direct apprehension of the 'indemonstrable' ultimate principles of the sciences and ἐπιστήμη as the 'mediated' knowledge of the consequences which follow by deduction from the principles. νοῦς ἐπιστήμη τε is rather to be regarded as a single concept, 'knowledge' as opposed to 'belief' or 'opinion', which may or may not be true. So we should not attempt to distinguish the δόξαι and πίστεις of b 8 from one another. ἐξ ἀνάγκης goes grammatically with the verb ἀποτελεῖται, 'νοῦς and ἐπιστήμη are the inevitable result'. But we should not do any violence to the thought of Timaeus if we said that he means that, though you can as a matter of fact have truth in a judgement about the sensible, your truth is merely 'assertory', only amounts to knowing that 'the fact is so'. This is converted into ἐπιστήμη, genuine science, as we are told in the *Meno* (98 a 3) αἰτίας λογισμῷ, by the discovery of the reason *why*, the connexion between the 'fact' and its rational ground. So long as a man does not see 'why' the 'fact is so', you have no guarantee for the permanence of his 'true opinion', it may 'desert' him (πολὺν δὲ χρόνον οὐκ ἐθέλουσι παραμένειν, ἀλλὰ δραπετεύουσιν ἐκ τῆς ψυχῆς τοῦ ἀνθρώπου, ὥστε οὐ πολλοῦ ἄξιαί εἰσιν, ἕως ἄν τις αὐτὰς δήσῃ αἰτίας λογισμῷ). In pure science, Arithmetic or Geometry, a proposition is *inferred* from the initial 'postulates' of the study. You see that *if* these postulates are true, the proposition in question must be true too; it becomes, always on the supposition that the 'postulates' themselves are free from error, a 'necessary' truth. You have thus already gone some way towards 'binding down' the true belief by the αἰτίας λογισμός. Still, these sciences themselves make no attempt to establish their own initial 'postulates'. They are content that the learner shall merely agree to raise no question about the 'postulates'. Hence, as modern students of the logic of the sciences tell us, all that is really established by any proof in Euclid is not that the proposition stated in the 'enunciation', e. g. the Pythagorean theorem, is true, but that it is true that this proposition follows from the body of unproved simpler propositions which Euclid expressly or tacitly 'postulates'. Dialectic, as the *Republic* conceives it, would really fulfil the demand for the production of the 'reason why', since it makes no 'postulates', but attempts by a critical examination of the unexamined 'postulates' of the other sciences to discover ultimate truths, ἀνυπόθετοι ἀρχαί, which we directly discern to

[1] Proclus explains quite correctly that τὸ λογιστικόν here = τὸ τῷ λογισμῷ τῆς ψυχῆς περιληπτόν, and rightly refers to 61 d 1 for a parallel use of αἰσθητικά.

be true, and to connect all other truths with them. Thus *ἀληθὴς δόξα* and *νοῦς ἐπιστήμη τε* differ very much as what Kant calls 'assertory' propositions differ from what he calls 'apodictic' propositions. But we must remember that Timaeus is himself one of the very fifth-century men of science whose procedure is criticized in the *Republic*, and must not attribute to him the distinction drawn by Socrates in that dialogue between Dialectic and 'Geometry and its sister studies', which, in fact, degrades the supreme Pythagorean science *ἀριθμητική, as pursued by the Pythagoreans*, to a secondary place.

37 c 3-5. *τούτω δὲ . . . ἐρεῖ.* *τούτω*, 'these two', refers not to *νοῦς* and *ἐπιστήμη*, which are not regarded here as a pair but as one thing, but to the two contrasted expressions, *δόξαι καὶ πίστεις* and *νοῦς ἐπιστήμη τε*; *δόξα* can no more exist outside a *ψυχή* than *ἐπιστήμη*. The proposition is not a tautology, since—in spite of the absence of any reference to *κίνησις* in the account of the 'ingredients' of *ψυχή*—Timaeus is throughout the present section thinking of the *ψυχή* as the 'self-moving' (*τὸ κινούμενον ὑφ' αὑτοῦ*). Hence to say that a thing which knows and judges must be a *ψυχή*, a source of spontaneous movement, is strictly a 'synthetic' proposition. The predicate is not to be discovered by any mere analysis of the subject-term. For the doctrine that thinking and knowledge are only to be found in a *ψυχή*—roughly it means that such phrases as 'impersonal thought', 'unconscious mind', and the like, are nonsense—see *Sophistes* 249 a, where the anonymous Eleatic argues that if 'what fully is' (*τὸ παντελῶς ὄν*) has *νοῦς*, it must have life (*ζωή*), and therefore must have *ψυχή*,[1] *Philebus* 30 c, where Socrates says that *σοφία* and *νοῦς* cannot exist *ἄνευ ψυχῆς*,[2] and *Timaeus* 30 b 8, where we have found Timaeus saying the same thing. The necessity of making the point will be clearer if we remember that though *νοῦς* means 'Mind' in Ionic, for example in Anaxagoras, it rarely, if ever, means that in classical Attic prose. There the meaning is much more often the 'sense' of a statement, the 'purpose' or 'intention' of an act or a plan of policy, or the like. So far as there is a classical Attic equivalent for 'the Mind', when *ψυχή* itself is not used, the word is more commonly *διάνοια*. The proposition that *νοῦς* only exists in a *ψυχή* thus means that there is really no such thing as the 'unconscious purpose' or '*de facto* teleology' of which some modern philosophers talk. This is why in *Laws* x the regularity and order of the great astronomical motions is taken as sufficient evidence that the universe is directed by an all-wise and perfectly good *ψυχή*. This is Plato's way of excluding Pantheism and asserting 'eternal providence'. It may be noticed that nothing is said here of *false* judgement, illusion, or error of any kind. The discussions of the *Theaetetus* show that Plato, like Descartes, understood that the real 'problem' of what is called the 'theory of knowledge' is not knowledge but error. The difficulty, if there is a difficulty, is not to explain

[1] *Sophistes loc. cit.* *ἀλλὰ νοῦν μὲν ἔχειν, ζωὴν δὲ μὴ φῶμεν;—καὶ πῶς;—ἀλλὰ ταῦτα μὲν ἀμφότερα ἐνόντ' αὐτῷ λέγομεν, οὐ μὴν ἐν ψυχῇ γε φήσομεν αὐτὸ ἔχειν αὐτά;—καὶ τίν' ἂν ἕτερον ἔχοι τρόπον;*

[2] *Philebus loc. cit.* c 9 *σοφία μὴν καὶ νοῦς ἄνευ ψυχῆς οὐκ ἄν ποτε γενοίσθην.—οὐ γὰρ οὖν.*

why our judgements are sometimes true but why they are ever anything else. The question does not arise at the present stage of the discourse of *Timaeus* because we are dealing not with any and every ψυχή but with the ψυχή of the οὐρανός. Why *we* men form false judgements is hinted in the words ὁ τοῦ θατέρου κύκλος ὀρθὸς ἰών and ὁ τοῦ ταὐτοῦ κύκλος εὔτροχος ὤν. The 'circles' in the cosmic soul are always exact; in *our* souls they are deformed and perturbed from causes to be mentioned later (43 c 7 ff.).

37 c 6—39 e 2. ὡς δὲ κινηθὲν . . . μίμησιν φύσεως. We come now to a philosophically profound passage which describes the creation of Time. Of course this is not to be taken literally, since it would then imply the absurd consequence that there 'was a time' when as yet there was no time. The real object is to explain the relation between time and eternity (αἰών), Plato's formula being that time is a 'moving image of eternity' (εἰκὼν κινητὸς αἰῶνος, d 5). The full meaning of this formula can hardly be discussed until we have examined some of the verbal difficulties of the passage. But we must note that we are told at the outset that Time was created to make the world 'still more like' its original (ἔτι δὴ μᾶλλον ὅμοιον πρὸς τὸ παράδειγμα ἐπενόησεν ἀπεργάσασθαι, c 8). That is, Timaeus means to insist not on the hackneyed contrast between time and eternity, but on their positive resemblance. They are not merely contrasted. Though time is not eternity, it is a real 'likeness' (a true 'perspective') of it.

37 c 6. τῶν ἀιδίων θεῶν γεγονὸς ἄγαλμα, 'a created image of the everlasting gods' (?), a thing in the making which is an image of gods (?) who are and are eternally complete. The phrase is a very difficult one, and it is hard not to believe either that the text is corrupt or that it has been universally misrendered. The original of which the οὐρανός is a copy is the νοητὸν ζῷον, which embraces all other νοητὰ ζῷα. That is, it is a Form (εἶδος). Now God, throughout the dialogue, is not a Form at all, but an agent fashioning the visible world on the pattern of the Forms. Moreover, there are as yet no 'gods' in our story, and all through the story there is only one God who can be called 'everlasting', the Creator himself. We shall hear later on of 'gods' in the plural, but they are not 'everlasting'; they are created, and created at a later stage than that we have reached. How then can the world be an 'image' of the 'everlasting gods'? There are no MSS. variants, and Chalcidius clearly read the words as we do, since he translates 'factum a se (γεγονός) simulacrum inmortalis divinitatis'. Cicero's version unfortunately has a lacuna at this point. In his Commentary (§ 105, ed. Wrobel, p. 173), Ch. assumes that the 'divinity' meant is the κόσμος νοητός ('mundus intellegibilis exemplum est mundi sensilis . . . imago quoque eius hic sensilis simulacro aeui facto atque instituto iungetur'). Clearly, this will not do as an interpretation for the reasons which have been given. Proclus has, to be sure, no difficulty in discovering a class of 'gods' in the plural intermediate between the αὐτοζῷον and the Demiurge, and showing that these beings can be called everlasting and that the sensible world can be regarded as an 'image' of them.[1] Unfortunately, whatever the merits of this

[1] Procl. *op. cit.* (Diehl) iii. 5 λείπεται οὖν εἶναι τοὺς ἀιδίους θεοὺς μετὰ τὸ αὐτοζῷον,

theology may be, there is no warrant in the dialogue for it. In the *Timaeus* there is only one 'everlasting God', the Demiurge Himself, and there is no hint that He derives His being from the *αὐτοζῷον*. Proclus, however, must have the credit for the good sense he shows in not equating the *θεοί* in question with *εἴδη*.[1]

There are one or two references to our passage in Plotinus which may be mentioned. At *Enn.* ii. 2. 2, Plotinus says with reference to the axial rotation attributed to the stars by Timaeus, *ἕκαστον γὰρ οὗ ἐστι περιειληφὸς τὸν θεὸν ἀγάλλεται οὐ λογισμῷ ἀλλὰ φυσικαῖς ἀνάγκαις*, a 'punning' allusion which merely proves that the word *θεῶν* was in the text as Plotinus knew it. In *Enn.* ii. 9. 8, arguing against the Gnostic pessimists who regarded the sensible world as evil, Plotinus refers to the life and 'wisdom' exhibited by it and asks *πῶς οὐκ ἄν τις ἄγαλμα ἐναργες καὶ καλὸν τῶν νοητῶν θεῶν εἴποι;* This again shows that Plotinus read *θεῶν* in the text; his expression *τῶν νοητῶν θεῶν* does not, of course, imply that his text of Plato had *νοητῶν* where ours has *ἀιδίων*. The *νοητῶν* is a piece of interpretation and proves that, in its general character, the exegesis of Proclus goes back at least to Plotinus. (Plato would not have spoken of *νοητοὶ θεοί*, as the phrase is only significant in virtue of the later Neo-Platonic distinction between *νοητοὶ θεοί* and *νοεροὶ θεοί* on the one hand, between *νοητοὶ θεοί* and the God who is above *νοῦς* on the other.) The numerous other references in Plotinus to the immediate context of our passage unfortunately throw no light on the particular words we are considering.

Of the modern editors, Stallbaum passes over the phrase without any comment except a general reference to the imitation of it by Neo-Platonists; Martin contents himself with the unfortunate remark that the 'everlasting gods' are 'obviously the Forms' (*idées*). A.-H. argues that, if the text is sound, the *εἴδη* must be meant, but rightly says that it would be an 'unparalleled expression' to call them *θεοί* and therefore suspects the text. For my part, I feel convinced that a reference to 'everlasting gods' in the *Timaeus*, which knows of no everlasting God but one, is out of the question. Yet the external evidence for the soundness of the text is quite good. I must leave it therefore to the reader to choose between two suggestions, to both of which objections can be raised. (*a*) If the text is sound, *θεῶν* cannot possibly mean 'gods'. But the word *might* be (though no one seems to have observed it) the gen.

πάντας ὄντας τοὺς μεταξὺ τοῦ τε νοητοῦ παραδείγματος καὶ τοῦ δημιουργοῦ. I.e., according to Proclus, the *νοητοὶ θεοί* are a hierarchy of which the *αὐτοζῷον* is the first, the *δημιουργός* the last, and the *ἀίδιοι θεοί* of our passage are the intermediate members.

[1] The interpretation had been given, but Proclus mentions it (*op. cit.* iii. 5) only to set it aside. *καὶ μάτην ἄρα ὑπέλαβόν τινες ἀιδίους λέγεσθαι θεοὺς τὰς ἐν τῷ αὐτοζῴῳ περιεχομένας ἰδέας, αἷς οὐ βούλεται τὸ πᾶν ὡμοιῶσθαι.* For we have not as yet heard of the creation of any of the subordinate species of *ζῷα*. If the *εἴδη* corresponding to 'animal types' were what are meant by the *ἀίδιοι θεοί*, the *οὐρανός* should be called not a *γεγονὸς ἄγαλμα* but an *ἐσόμενον ἄγαλμα* of them, something which *would* be a copy of them when the various animals came to exist. When we remember that the only *εἴδη* actually mentioned by Timaeus are those of the four 'roots' and of the various types of organisms, this criticism appears perfectly conclusive. We could not e.g. suggest that the *ἀίδιοι θεοί* are the Platonic Number-Forms, for Timaeus never refers to these at all.

plur. of *θέα*. The meaning would then be 'an image of his (the Creator's) everlasting objects of contemplation', i. e. of the *εἴδη*. This would give a satisfactory sense, and for the employment of *θέα* in the sense of *θέαμα*, an *object* contemplated, we might adduce *Phaedrus* 247 a 4 *πολλαὶ μὲν οὖν καὶ μακάριαι θέαι τε καὶ διέξοδοι ἐντὸς οὐρανοῦ, ἃς θεῶν γένος εὐδαιμόνων ἐπιστρέφεται πράττων ἕκαστος αὐτῶν τὸ αὑτοῦ* and again *Rep.* x. 615 a 3 *τὰς δ' αὖ ἐκ τοῦ οὐρανοῦ εὐπαθείας διηγεῖσθαι καὶ θέας ἀμηχάνους τὸ κάλλος*. I do not feel sure that this is not the complete solution of our puzzle, though I confess that, like some better scholars to whom I have submitted the suggestion, I feel a dislike of the expression 'his everlasting *θέαι*' for which I cannot adduce any very definite reason.[1]

(*b*) If the text is wrong, we must be dealing with a corruption older than Plotinus and probably as old as Dercylides. Such an error is not likely to extend to more than a few letters, and, since it must cover the objectionable *θεῶν*, the *ἀιδίων* is likely to be right here, especially as a word of that sense is required by the antithesis with the following *γεγονός*.[2] The simplest 'emendation' would be to omit *θεῶν*; we should then have simply *τῶν ἀιδίων γεγονὸς ἄγαλμα*, 'a created image of the everlasting'. The phrase and sense are unimpeachable, but how are we to account for the early intrusion of *θεῶν* into the text? May it be that the *-ων* of *ἀιδίων* was first accidentally repeated by 'dittography' and then misread ΘΝ e. g. *θεῶν*? But though it is generally admitted that *nomina sacra* are the earliest words to be written with contractions in our MSS., the practice seems to be due to Christian scribes, and it may be doubted whether such a form as $\overline{\Theta N}$ is likely to have been used early enough to account for so ancient and universal a corruption. Not being an expert in palaeography, I have no right to a decided opinion of my own on such a question, but I understand that it is improbable that contractions of the *nomina sacra* were used in MSS. of 'gentile' Greek authors early enough to account for the origination of a reading as old as the *textus receptus* of our passage. (Perhaps I need hardly add that it would be no way out of the difficulty to suppose that *θεῶν* is a corruption of e. g. *ἰδεῶν*. The words are not sufficiently like one another, and *ἀίδιοι ἰδέαι* would itself be an *expression* hard to match anywhere in Plato. And nothing has as yet been said by Timaeus about the Forms, so that *ἰδεῶν* here, without any prefatory explanation, would be a painfully puzzling word.)

37 d 1–7. καθάπερ οὖν . . . ὠνομάκαμεν. The *αὐτό* of d 1 is, of course, the *νοητὸν ζῷον*, which is the Creator's model. The thought is that only that which is *αἰώνιος*, 'eternal' in the sense that it knows no 'passage',

[1] But we may remember that the Creator *πρὸς τὸ ἀίδιον ἔβλεπεν* (29 a 3). Perhaps this ought to decide in favour of retaining *θεῶν* and taking it as a case of *θέα*.

[2] The *γεγονός* seems to me to show that *ἀιδίων here* is sound. But *ἀίδιος* is itself a word liable to arise as a corruption of *αἴτιος* or *αἰτία*. E.g. in Aristot. *Met.* A. 993^{b} 22, where the codex Laurentianus A^{b} reads *οὐκ ἀίδιον*, the Paris MS. E has *οὐ τὸ αἴτιον*, and Alexander records this as a variant known to himself. This may perhaps throw some light on one of the most difficult cruces of Plato's text, *Philebus* 66 a 8 *ἀλλὰ πρῶτον μέν πῃ περὶ μέτρον καὶ τὸ μέτριον καὶ καίριον καὶ πάντα ὑπόσα χρὴ τοιαῦτα νομίζειν τὴν †ἀίδιον ῥῆσθαι*. (This, the reading of B, and, as I am now informed by Professor Burnet, of W, is far the best accredited MSS. text.) May it not be that *ἀίδιον* here is a corruption of *αἰτίαν*? Cf. *Phileb.* 65 a 1–5.)

is never 'in the making', can strictly be called ἀΐδιος, 'everlasting'. But that which, though always 'in the making', endures through *all* time is in a secondary sense an approximation to the everlasting. The παράδειγμα is not a thing 'in the making' at all; passage and succession have nothing to do with it; it has its being in αἰών, eternity. (It is this 'completeness' or 'once for all' character which Henry Vaughan has in view in his famous description of eternity as 'a great ring of pure and *endless* light'.) The sensible world is a thing of passage, but it never passes *away*; its passage fills *all* time, and, of course, the formal laws of its structure remain the same throughout. So it really is a moving or passing 'image' of the truly abiding (εἰκὼν κινητὸς αἰῶνος, μένοντος αἰῶνος ἐν ἑνὶ κατ' ἀριθμὸν ἰοῦσα αἰώνιος εἰκών). I.e. time, which is *measured* duration, may be said to be, in virtue of its character as measurable, an image of eternity. It is to eternity as the series of integers (the ἀριθμοί) are, on the *Pythagorean theory of number*, to the unit or number 1. The unit was regarded as at once odd and even, as the first member of all the various series of 'triangular', 'square', 'pentagonal', and other 'figurate' numbers. The special properties of each integer or class of integers thus form a partial selection from those which were supposed to be all present together in 'the unit'.[1] Time has a like relation to 'eternity'. To use a metaphor, we might say that the integers are thought of as 'shadows' or 'projections' or 'perspectives' of the 'unit', time as a 'shadow' or 'projection' or 'perspective' of αἰών. By 'time' Timaeus here means what is often called 'Newtonian' time, the 'absolute, true, or mathematical time', which, in the famous words of the *Principia*, 'flows equably'. It is thought of as measured, or rather numbered, by a succession of equal intervals, days or years or what not, just as in the Pythagorean arithmetic numbers were thought of as repetitions of an 'absolute' and indivisible 'unit'. The thing meant is thus what is often called depreciatingly 'clock-time' (the clock being thought of as free from all the defects of our actual time-pieces).

37 d 5. διακοσμῶν ἅμα οὐρανόν, 'in the very act of ordering (lit. 'marshalling') the οὐρανός'. The revolution of the eight circles *is* 'time'. There are not two separate stages in fact, though in the narrative we have

[1] Cf. Iamblichus *in Nicomachi Introd.* 12 (ed. Pistelli p. 11) τινὲς δὲ ὡρίσαντο μονάδα εἰδῶν εἶδος, ὡς δυνάμει πάντας περιέχουσαν τοὺς ἐν ἀριθμῷ λόγους. καὶ γὰρ πολύγωνος ἐν ἐπιπέδῳ ἀπὸ τριγώνου μέχρι ἀπείρου, καὶ στερεὰ πᾶσιν εἴδεσιν ἐπιφαινομένη, καὶ σφαιρικὴ καὶ κωνική, ἀποκαταστατική τε καὶ πλευρικὴ καὶ διαμετρικὴ κτλ. The terminology (δυνάμει πάντας περιέχουσαν) is that of a later age, but the material is not the kind of thing the Neo-Pythagoreans invented for themselves. The point may be illustrated from the special case of the 'polygonal' numbers thus. The most general formula by the aid of which we can construct all the series of 'polygons' is the expression for the nth m-agonal number (n and m ranging over the whole field of the integers). This formula, though not actually given by ancient writers, is easily deducible from the rules for forming the 'polygons' in Theon Smyrnaeus (Hiller, pp. 36–41), and is $n + \frac{n(n-1)(m-2)}{2}$. It follows at once that if we put $n = 1$ the expression reduces to $1 + \frac{1 \times 0}{2} = 1$, no matter what value we give to m; i.e. 1 is the first term of every series of 'polygons'.

first to speak of the 'making' of the 'circles' and then of the 'making' of 'time'. The two are aspects of the same process.

37 e 1–3. ἡμέρας γὰρ . . . μηχανᾶται. The sentence opens as though *ἡμέρας καὶ νύκτας καὶ μῆνας καὶ ἐνιαυτούς* were to be accusatives after the main verb, but before it is finished the construction is changed, so that instead of being governed directly by *μηχανᾶται* the accusatives are in anticipatory apposition to the grammatical object-accusative *τὴν γένεσιν αὐτῶν*. The point is that time is not something existing before or after or besides the events which make up the life of nature, a sort of frame into which the events are put, which might still be something with a structure of its own, if there were no events to fill it. It is itself a character of the events, or rather an expression of *the* most universal character of nature, its 'passage'. Fully thought out this implies a thoroughgoing 'relativist' theory of time such that an empty time, a time without events, like that which Newton is rightly or wrongly credited with asserting, is a phrase without meaning.

37 e 3—38 b 5. ταῦτα δὲ πάντα . . . διακριβολογεῖσθαι. It follows that expressions involving *tense* do not accurately describe what is 'eternal'. We often employ them (as when God is said to be He who is and was and is to be, or as when we say that the longer side of a triangle *always* subtends the greater angle), but such language is incorrect. 'Was', 'is', 'will be' are distinctions which only apply to *nature*, that which is always 'in the making' (or to *ψυχή*, for the same reason). It is *γένεσις*, the character of 'being in the making', in virtue of which these distinctions belong to *αἰσθητά* (38 a 6 *ὅσα γένεσις τοῖς ἐν αἰσθήσει φερομένοις προσῆψεν*). Of that which does not 'pass' at all we can only say that it just 'is' such and such, and the 'is' of such a statement is not a present as opposed to a past or future. It is not the 'is' which means 'is at this moment'; in fact it is a 'timeless present', as the 'gnomic aorist' in Greek is a 'timeless' past. On the other hand, when we say that the past event *is* past, what is happening now *is* now, what will happen *is* future, Timaeus holds that we are misusing the word *is*, using it 'catachrestically'. Properly *is* should only be said of that which does not 'pass' at all. (Cf. the view of some psychologists that the 'present' has no duration but is a 'knife-edge'.) Exactly in the same way we *say* of something which is quite unreal, a Centaur or 'the greatest of all the integers', that it *is* a 'non-entity' (*τὸ μὴ ὂν μὴ ὂν εἶναι*, 38 b 2). This, too, is an inexact use of the word 'is'. These remarks are made because the ambiguities of the word 'to be' gave rise in the early days of Logic to tiresome fallacies. Thus if you say that an event *is* happening, some one might object that if it *is*, it does not happen, the happening is over; if it happens it cannot be said to 'be'. What, e.g., do you mean when you say of a falling body, which continuously increases in velocity, that its velocity 'at this moment' *is* x feet per second? This is a real problem of the very kind which inspired Zeno's famous arguments about motion. But the confusions and ambiguities attendant on the use of the tenseless 'copula' also gave rise to a different set of difficulties which were exploited (as we see from Plato's *Sophistes*) for the purposes of mere eristic. You say that *A* is not *B*, e.g. that Socrates is not Theaetetus. This seems to be saying in

one breath that *A is* and also that *A* is *not*. I can hardly *mean* that Socrates has no being at all, yet I seem to be *saying* so. This particular difficulty about the meaning of a negative proposition was first thoroughly cleared up by Plato himself in the *Sophistes*. To us it seems obvious that '*A* is not *B*' does not mean that *A* is nothing at all, but only that it is something *different* from *B*. But the explanation, first given in the *Sophistes*, only seems so obvious because the teaching of the dialogue has been incorporated into the tradition of logic and made 'current coin'. Timaeus is not supposed to know anything about the logical doctrine of the *Sophistes*, and consequently he does not, like Plato in that dialogue, assert that τὸ μὴ ὂν ἔστι πῃ, that 'what is not' in one sense 'is' in another sense. He retains the hard and fast antithesis between what 'is' and what 'is not' exactly as Socrates does in the *Republic*, and holds that, to escape ambiguities, we ought properly to avoid using the word ἔστι with reference to any subject which 'passes' or 'becomes'. Of γιγνόμενα we may only use the past and future forms ἦν and ἔσται. We may not even say of a past event that it *is* a γεγονός or of a future that it ἐστὶ γενησόμενον, if we would speak with any precision. No doubt the words used by Timaeus are meant to recall the familiar verses of Parmenides οὐδέ ποτ' ἦν οὐδ' ἔσται, ἐπεὶ νῦν ἔστιν ὁμοῦ πᾶν, | ἕν, συνεχές (Fr. 8, R. P. 147), and οὐ γὰρ μήποτε τοῦτο δαμῇ εἶναι μὴ ἐόντα (Fr. 7, R. P. 146). Timaeus belongs to the school against whom the polemic of Parmenides is most specially directed, but we see that he has pondered and learned from the polemic.

38 a 3. οὔτε πρεσβύτερον οὔτε νεώτερον. How does anything grow 'younger' by lapse of time? Timaeus really means only to say that the 'eternal' grows no *older* as time goes on. But the Greek fondness for 'polar antithesis' leads to the expression that a thing that gets older is growing πρεσβύτερον αὐτὸ αὐτοῦ, i. e. older than it was at the beginning of the process. It follows, of course, that what has become 'older than itself' must also have become 'younger than itself', since 'younger than' is the converse relation to 'older than'. This is how Timaeus comes to say 'to grow older or younger' when he means only what we express by 'to grow older'. Compare *Charm.* 168 c 10 and the intentionally humorous use of the same phrase in *Parm.* 140 e 1–141 a 6, and 151 e 3–153 b 7. The διὰ χρόνου of A gives a much better sense than the διὰ χρόνον of F. χρόνος is thought of as the agent which wears out the life of things, as in the lines of Sophocles, *Ajax* 646–7 ἅπανθ' ὁ μακρὸς κἀναρίθμητος χρόνος | φύει τ' ἄδηλα καὶ φανέντα κρύπτεται.

38 a 8. καὶ πρὸς τούτοις ἔτι τὰ τοιάδε κτλ., sc. πρέπει λέγεσθαι περὶ τὴν ἐν χρόνῳ γένεσιν ἰοῦσαν, the words from κινήσεις γάρ to γέγονεν εἴδη forming a long parenthesis.

38 b 3–5. περὶ μὲν οὖν . . . διακριβολογεῖσθαι. This is one of the places where Plato seems to give us a plain hint that he has not said his last word through the mouth of Timaeus. There is more which he could say about the resemblances and differences between αἰών and χρόνος, but he must not say now more than would be appropriate to a fifth-century Pythagorean exposition of cosmology. Unfortunately for us, there is no place in Plato where the more minute discussion Timaeus thinks irrelevant

to his purpose is given. We might perhaps think of the subtle discussions about the notions of 'an instant' (τὸ ἐξαίφνης) and of the continuity or discontinuity of κίνησις in *Parmenides* 155 e 4—157 b 5, but we cannot be sure how much of all this Plato means to inculcate seriously. We are expressly told (*Parm.* 135 c–e) that the 'antinomies' put into the mouth of Parmenides are meant as a γυμνασία, a preparatory 'exercise' in hard thinking. Plato offers no solution of any of them.

38 b 6–9. χρόνος δ' οὖν . . . κατὰ δύναμιν ἦ. δ' οὖν is the usual combination of particles when a writer or speaker comes back to his main subject after breaking off a digression which he thinks it irrelevant to pursue. 'Be that as it may, at any rate time came to be along with the οὐρανός and will never come to an end unless the οὐρανός comes to an end too.' We know already that in the opinion of Timaeus the οὐρανός will not come to an end. He has told us already that it was launched by God on an unceasing life for the *whole* of time (36 e 4 θείαν ἀρχὴν ἤρξατο ἀπαύστου βίου πρὸς τὸν σύμπαντα χρόνον). We shall see later on that there are even finite beings within the οὐρανός who, though not indestructible in their own right, are *de facto* never to be destroyed. The reason *why* the οὐρανός is to endure for all time is that if it did not it would not be 'as like' its 'eternal' prototype as it could be made.

38 c 2–3. διὰ τέλους τὸν ἅπαντα χρόνον γεγονώς τε καὶ ὢν καὶ ἐσόμενος. We have already seen sufficient grounds for refusing to find in the *Timaeus* the notion of alternate cycles, or rather half-cycles, of growth and decay of the οὐρανός. It is not meant that the οὐρανός is now, has been, because it has been produced an infinite number of times in previous cycles, will be, because it is to be produced again an infinite number of times in cycles to come. What is meant is simply that at every moment of time there are present events which were preceded by past events and will be succeeded by future events, i.e. that there never was a first event and never will be a last event. There are plenty of allusions in Plato to support the view that all processes within the κόσμος from the revolution of the ἀπλανές to the life-history of an insect have their rhythmic periods, but there is nothing to show that he held that the whole cosmical process as a whole is cyclical or that he believed in the 'point-to-point' repetition of any series of events like the Pythagoreans of whom Eudemus speaks, or the Stoics or Nietzsche. As to the actual words, the Italian translator Fraccaroli seems to me *probably* right in holding that the subject ὁ (c 2) means χρόνος rather than the οὐρανός, in spite of the redundancy of the following τὸν ἅπαντα χρόνον. From this passage are derived the formulations given by later writers of Plato's definition of Time. Theophrastus appears to have taken the definition to be ἡ τοῦ ὅλου περιφορά, or ἡ τοῦ ὅλου κίνησις (Theophr. φυσικαὶ δόξαι Fr. 15, *Doxogr. Graec.* 492). Cf. [Plat.] *Definit.* 411 b 3 χρόνος ἡλίου κίνησις, μέτρον φορᾶς; Aristot. *Phys.* Δ. 218ᵃ 33 οἱ μὲν γὰρ τὴν τοῦ ὅλου κίνησιν εἶναί φασιν, οἱ δὲ τὴν σφαῖραν αὐτήν, where the first clause seems to refer to the account of the *Timaeus*; Aetius, *Placit.* i. 22 (*Doxogr. Graec.* 318) Πλάτων οὐσίαν χρόνου τὴν τοῦ οὐρανοῦ κίνησιν. Xenocrates is said in the same passage to have given the definition μέτρον τῶν γενητῶν καὶ κίνησις ἀίδιος, and the Academic φυσικός Histiaeus φορὰν ἄστρων πρὸς ἄλληλα, Speusippus (Plutarch,

Quaest. Platonic. 1007 b) *τὸ ἐν κινήσει ποσόν*, which comes very near Aristotle's *ἀριθμὸς κινήσεως κατὰ τὸ πρότερον καὶ ὕστερον* (*Phys.* Δ. 219^{b} 2). There was a question whether Plato means that time actually *is* uniform movement or only that it is measured by such movement. On this dispute see A. Levi, *Il Concetto del Tempo nei suoi Rapporti coi Problemi del Divenire e dell' Essere nella Filosofia di Platone*, pp. 98–9. It seems to me, as I gather also to Mr. Levi, that the *language* of Timaeus plainly *identifies* time with the uniform movement of a planet.

38 c 5–6. ἥλιος καὶ σελήνη . . . γέγονεν. Time, as we have seen, means equable succession. If there is to be equable succession, time must be measurable. Hence for the origination of time the 'planets' are said to be made to be the world's great natural time-keepers. (Of course the *ἀπλανές* plays this part also, since its revolution is the *νυχθήμερον*, the 'natural day' of twenty-four hours. But we should not advance far in the measurement of time if the *νυχθήμερον* were the only regular period we could determine.) Timaeus is thinking of the astronomical problem of the construction of the Calendar, and hence specially names the 'planets', especially sun and moon from whose revolutions we get the division of time into months and years, the starting-point of the student of the Calendar. Strictly speaking, the reference is to the *souls* which Timaeus and Plato himself believe to animate the 'heavenly bodies', as is shown by the fact that the actual making of the bodies is described as a distinct act at c 7. Plato is similarly careful at *Laws* x. 898 d—899 b to distinguish between the souls which guide the planets and the planetary bodies, and to make it clear that it is these *souls* and not the visible heavenly *bodies* that he regards as divine. It is the *ψυχή* of the sun, whether we suppose it to be 'in' the sun or to be connected with it in any way we like, that a man should look on as divine (*Laws* 899 a 7 *αὐτοῦ δὴ ἄμεινον ταύτην τὴν ψυχήν, εἴτε ἐν ἅρμασιν ἔχουσα ἡμῖν ἥλιον ἄγει φῶς τοῖς ἅπασιν, εἴτε ἔξωθεν, εἴθ' ὅπως εἴθ' ὅπῃ, θεὸν ἡγεῖσθαι χρεὼν πάντα ἄνδρα*).

38 c 5–6. ἐπίκλην ἔχοντα πλανητά. The name is worth noting. The word is, as Bt. has more than once reminded us, a disrespectful nickname, the 'tramps' or 'vagabonds' of the sky. Probably, as he has also said, it is the use of this name for the 'wandering stars' which explains why Timaeus later on calls the contingent and incalculable element in fact the *πλανωμένη αἰτία* or 'errant' cause. Greek astronomy at first took little notice of the planets, and the reason is a highly creditable one to the Greeks. To the practical man the planets are of no particular importance. The 'fixed' stars, the 'householders' of the heavens, are of great importance. They serve the navigator and the farmer by enabling a man to steer his course at sea and to find his bearings by night on land. The risings and settings of some of them indicate the approach of the rains, the closing of the sea to navigation for the winter, the times for various agricultural operations. All this was known to the Greeks before the rise of science, and we read much about it in Hesiod's *Works and Days*. Hence when science did arise it was natural that it should concern itself with the real nature of the bodies in which mankind had already learned to take a practical interest. But the 'planets' proper (I do not speak of the sun and moon, which are, of course, important to the

practical man) are of interest in pre-scientific days only to persons imbued with astrological superstition. They had been watched by the astrologers of Babylon long before the Greeks began to construct theories of the heavens. The Greeks were singularly free from the superstition of astrology, which is unmentioned in their classical literature and appears only to have been brought to the Hellenic world in post-classical times, mainly through the influence of Stoics who were themselves natives of Oriental cities. Consequently, the early astronomers, whatever they may have borrowed from Babylon, let the superstitious features of Babylonian *Sternkunde* drop. They busied themselves with the question of the nature and movements of the stars, but seem at first to have ignored the planets almost wholly. As we have seen, Pythagoras seems to have been the first even to make the simple identification of the 'morning' with the 'evening' star. Similarly, the Pythagoreans were so little interested in the comets which have often been objects of superstitious dread that they regarded them as reappearances of one single planet which they called ὁ κομήτης, '*the* long-haired planet'. (Aristot. *Meteorologica* A. 342^{b} 29 *τῶν δ' Ἰταλικῶν τινες καὶ καλουμένων Πυθαγορείων ἕνα λέγουσιν αὐτὸν εἶναι τῶν πλανήτων ἄστρων, ἀλλὰ διὰ πολλοῦ τε χρόνου τὴν φαντασίαν αὐτοῦ εἶναι καὶ τὴν ὑπερβολὴν ἐπὶ μικρόν.* Thus the Pythagoreans have the merit of having recognized from the first that comets are members of the solar family, a truth which was vehemently denied even by Galileo in his controversy with Father Grassi.) The men of science would, moreover, naturally not spend much of their thought at first on the planets, precisely because it is comparatively so hard to discover any definite law in their apparently aimless rambling over the sky. It is characteristic of the Greek attitude to astrology that though Aristophanes makes fun of astronomers like Meton who set himself to correct the Athenian Calendar, he never so much as mentions astrological charlatans like the *mathematici* who are butts of the Roman satirists.

38 c 6. εἰς διορισμὸν καὶ φυλακὴν ἀριθμῶν χρόνου. They 'divide' or 'determine' the numbers, because we use their revolutions as units for measuring time; they 'guard' the numbers, keep them safe, in fact provide a *standard* measure, in virtue of the equability of the revolutions.

38 c 7. σώματα δὲ αὐτῶν. From the point of view of Timaeus it is the ψυχαί which are *αὐτὰ τὰ ἄστρα*. Cf. the discussion in the *Laws* referred to in the note on ἥλιος . . . πλανητά, 38 c 5, *Laws* x. 898 d 3—899 c 1, with its conclusion *ἐπειδὴ ψυχὴ μὲν ἢ ψυχαὶ πάντων τούτων αἴτιαι ἐφάνησαν, θεοὺς αὐτὰς εἶναι φήσομεν, εἴτε ἐν σώμασιν ἐνοῦσαι, ζῷα ὄντα, κοσμοῦσιν πάντα οὐρανόν, εἴτε ὅπῃ τε καὶ ὅπως.* Note that, as often, even the oblique case αὐτῶν has not quite sunk to the colourlessness of our 'pronoun of the third person'; it is = *ipsorum* rather than *eorum*, (*As You Like It*, V. 1 'all your writers do consent that *ipse* is he: now, you are not *ipse*, for I am he').

38 d 1–3. σελήνην μὲν . . . ἰόντας. This settles for us the order of the first four of the seven πλανητά as Moon, Sun, Venus, Mercury. The same order is found in the myth of Er, and appears to have been that generally recognized by the Pythagorean astronomers of the fifth century, who thus missed a truth which Anaximander had already grasped if his

'wheel' of the stars is really meant to contain just the 'morning' and 'evening' planets. The correct order, Moon, Mercury, Venus, Sun, is given by Theon of Smyrna (ed. Hiller, p. 138) as that of τινὲς τῶν Πυθαγορείων, but he produces no authority for it older than Alexander (? of Aetolia), unless we may assume that the phrase καρδία τοῦ παντός mentioned by Theon and others as a name for the sun implies that the sun holds the central position, and may also be taken to be Pythagorean, (though it *might* possibly be Stoic, since the Stoics, like Aristotle but unlike Alcmaeon and Plato, regarded the heart as the central organ of the sensori-motor system). *Epinomis* 986 a—987 b implies the same order as the *Republic* and *Timaeus*, so that this is clearly the arrangement adopted by Plato. Eudoxus and Aristotle followed the same order (cf. Aristotle *Met.* Λ. 1073^{b} 17 ff. and Proclus *in loc.* [Diehl iii. 62] καὶ γὰρ Ἀριστοτέλης οὕτως ᾤετο καὶ οἱ ἀμφὶ τὸν Εὔδοξον). According to Proclus (Diehl iii. 63) Anaxagoras was recorded by Eudemus to have adopted the same order, Ἀναξαγόρας τοῦτο πρῶτος ὑπέλαβεν (viz. that the sun comes next in order to the moon) ὡς ἱστόρησεν Εὔδημος. (This, no doubt, means no more than that Eudemus knew of no author earlier than Anaxagoras, who had given the arrangement. As the early Pythagoreans did not write books, the statement of Eudemus is no reason for doubting that they also followed this arrangement; the question of the order of the planets must have been raised by them in connexion with their theory of the ἁρμονία in the heavens.) According to the *Placita* of Aetius ii. 7. 7, Philolaus definitely said, like Timaeus, that the sun was next to the moon (τοὺς πέντε πλανήτας, μεθ' οὓς ἥλιον, ὑφ' ᾧ σελήνην), but this most likely only means that the order was given in the work known in later times as 'Philolaus'. Among later men of science Eratosthenes seems still to have clung to the Platonic arrangement, except that he placed Mercury immediately after the sun and before Venus (Theon 142, Chalcid. *Comment.* § 72). In Alexandrian times it came to be gradually realized that the sun must be placed beyond Mercury and Venus if the appearances are to be 'saved'. We get the now received order for the 'planets' in Cicero *Somnium Scipionis* 17. Macrobius (*in Somnium Scipionis* i. 18. 2) says that Cicero is here following Archimedes and the tradition of the 'Chaldaeans'; the older arrangement he believes to be 'Egyptian'. Apparently the pure astronomers were not absolutely agreed on the new arrangement even in the Alexandrian age. At least Theon (*op. cit.* 143) says that the μαθηματικοί were not unanimous, and speaks as though they still placed the sun next to the moon, and only disagreed about the positions of Venus and Mercury. I suspect, however, that this only means that Eratosthenes, the one μαθηματικός whom Theon names, followed the old order except for its misplacement of Mercury. Pliny (*H. N.* ii. 6) definitely adopts the new order ('eorum medius sol fertur'). So, rather earlier, Philo (*Vit. Mosis* iii. 9) ὁ γὰρ ἥλιος . . . μέσος τῶν ἑξ τεταγμένος. The pseudo-Aristotelian *de Mundo*, on the other hand (392 a 19 ff.), gives the Platonic arrangement and mentions no other. The final establishment of the true order of the 'planets' was due to the authority of Ptolemy, (see Proclus, ed. Diehl iii. 62–3, and *Hypotyposis* vii. 19 [ed. Manitius, pp. 220 ff.]). Yet even in

the fifth century of our era, enthusiastic Platonists could still attempt to defend the old Platonic and Pythagorean arrangement on the ground that Ptolemy's arguments are not absolutely demonstrative. Proclus actually (*op. cit.* iii. 63) calls them mere πιθανολογία (τῶν μὲν μαθηματικῶν οὐ πολὺς λόγος πιθανολογούντων), though they were in fact based on a careful computation of the perigee and apogee of the planets in question (see the editor's note to *Hypotypos. loc. cit.*). Macrobius (*op. cit.* i. 18. 3) defends the Platonic order by the false assertion that the moon is the only body which shines by reflected light and consequently the only one which is 'below' the sun. For further references to ancient theories about the order of the planets consult Martin *Études* n. 32.

38 d 2. τὸν ἱερὸν Ἑρμοῦ λεγόμενον. This appears to be the earliest instance in extant Greek literature of the use of a 'name' for a planet. The full list of the 'names' of the gods after whom the planets are called is given for the first time in *Epinomis* 987 b–c. It is said there that the ἐπωνυμίαι—they are not, strictly speaking, 'names' (ὀνόματα), but 'designations' (star *of* such and such a god)[1]—came originally from Syria. The present passage implies that the name 'star of Hermes' had already found its way to the Greeks as early as the time of Plato's birth. It was apparently the first of these ἐπωνυμίαι to establish itself, and is the only one used anywhere by Plato except in the *Epinomis* passage. Aristotle uses the designations 'star of Hermes', 'star of Aphrodite' for Mercury and Venus, 'star of Zeus' and 'star of Cronus' for Jupiter and Saturn (*Met.* Λ. 1073^{b} 31–5) once. It should be noted that the employment of the divine names as actual *names* of the planets is later. At first the practice is to say ὁ τοῦ Ἑρμοῦ ⟨ἀστήρ⟩, stella Mercurii, and the

[1] Thus the god from whom the ἐπωνυμία is taken stands to the planet as the ἄρχων stood to his year of office, or as the 'eponymous' heroes of the Attic 'tribes' stood to the tribes. 'Callias' was not the name of the year 412–411 in which the 'Four Hundred' were set up, nor 'Euclides' the name of the year 403–402, the first of the 'restored' democracy, but those years were 'called after'—in the American phrase 'named for'—Callias and Euclides, and were currently spoken of as year of Callias, year of Euclides. The association of Ares with the 'red' planet appears in the Homeric hymn to Ares (*Hymn.* viii. 6), where the god is addressed as ἠνορέης σκηπτοῦχε, πυραυγέα κύκλον ἐλίσσων | αἰθέρος ἑπταπόροις ἐνὶ τείρεσιν, ἔνθα σε πῶλοι | ζαφλεγέες τριτάτης ὑπὲρ ἄντυγος αἰὲν ἔχουσι. The age of the poem is unknown, though the (Orphic) ideas it embodies are ancient enough. There seems to be nothing in the language to exclude a date as early as the fifth century. The same planet was sometimes called the star of Heracles (Theon 130, Pliny *N. H.* ii. 8, Macrobius *Saturnal.* iii. 12. 6) or of Apollo (Macrobius *Saturnal.* i. 19. 7). These names appear to have been less usual than that which has become traditional with us, since in the first of the passages quoted from Macrobius, the use of the name of Heracles is said to be 'Chaldaean', 'reliqui *omnes* Martis appellant', and in the latter, the appeal is to the nomenclature of unspecified 'peoples', 'apud multas gentes stella Mercurii ad Apollinis nomen refertur'. Venus was alternatively called the star of Hera or of Isis (*Timaeus Locrus* 96 e δύο δ' ἰσόδρομοι δελίῳ ἐντί, Ἑρμᾶ τε καὶ Ἥρας, τὸν Ἀφροδίτας καὶ φωσφόρον τοὶ πολλοὶ καλέοντι, Pliny *N. H.* ii. 8 'alii enim Iunonis, alii Isidis, alii Matris Deum appellavere'). Saturn had also the alternative name 'star of the sun' (Theon 120 Φαίνων τε ὁ τοῦ Κρόνου προσαγορευόμενος, ὡς δέ τινες Ἡλίου). This name appears to be as old as the fourth (? fifth) century, since at *Epinomis* 987 c 4, where it is said, according to our texts, Κρόνου αὐτόν τινες ἐπωνυμίαν φθέγγονται, A and O agree in the variant ἡλίου for Κρόνου. This is clearly likely to be the genuine reading, and should be restored to the text. Κρόνου is clearly intelligible as a gloss on ἡλίου, but not ἡλίου as a gloss on the familiar Κρόνου.

like, not to use the god's name in the nominative as an actual appellation of the planet.[1] Alternatively in Greek the planets (exclusive of sun and moon) are called by fixed adjectival epithets, Saturn was *φαίνων*, the bright, Jupiter *φαέθων*, the brilliant, Mars *πυρόεις*, the fiery, Venus *ἑωσφόρος* or *φωσφόρος*, the star that brings the light, or *ἕσπερος*, the 'evening' star, Mercury *στίλβων*, the gleaming. The full list of epithets does not seem to be accredited by any very ancient author, though it occurs, in conjunction with the designations after the gods, in the set of verses quoted by Theon (*op. cit.* 139) from Alexander (? of Aetolia).[2] This is *perhaps* the earliest occurrence of the whole list, but the individual epithets may be of any age. *ἕσπερος* occurs in the Iliad (X. 318 *ἕσπερος ὃς κάλλιστος ἐν οὐρανῷ ἵσταται ἀστήρ*), apparently as virtually a proper name, *ἑωσφόρος* is in Hesiod (*Theogony* 381 *τοὺς δὲ μέτ' ἀστέρα τίκτ' Ἠοσφόρον Ἠριγένεια*). The other epithets may well be much less ancient, but *πυρόεις* 'ruddy' is likely to be old enough, and seems to be alluded to by the word *πυραυγέα* in the *Hymn to Ares* as well as by the *ὑπέρυθρον* of *Republic* 617 a 4, and the *ἐρυθρώτατον ἔχει χρῶμα* of *Epinomis* 987 c 7. (The Lexicons refer to [Arist.] *de Mundo* and Cicero *de Nat. Deorum* as the earliest authorities for the full list, and these will be the earliest occurrences in extant literature if Theon is really mistaken about the authorship of the verses he quotes. Of course the use of the names may be much older. There is no sufficient reason to doubt that they are as old as Plato or even as Timaeus, though we happen to be unable to prove the point.)

[1] I owe the following references largely to my friend and late colleague Mr. W. L. Lorimer. *De Mundo* 399[a] 9 *ὁ Ἑρμῆς λεγόμενος*, as printed by Bekker, is the reading of all MSS. except two (C G), which have *Ἑρμοῦ*. (*Ἑρμοῦ* may, however, be right; cf. ib. 392[a] 26 *ὃν ἱερὸν Ἑρμοῦ καλοῦσιν ἔνιοι*.) Mr. Lorimer refers also to the passage from Aristotle *Metaphysics* Λ noted in the text, *εἶναι δὲ τῆς τρίτης σφαίρας τοὺς πόλους τῶν μὲν ἄλλων ἰδίους, τοὺς δὲ τῆς Ἀφροδίτης καὶ τοῦ Ἑρμοῦ τοὺς αὐτούς . . . τὸ δὲ πλῆθος τῷ μὲν τοῦ Διὸς καὶ τῷ τοῦ Κρόνου τὸ αὐτὸ ἐκείνῳ ἀπεδίδου*. But here *τῷ τοῦ Διός, τῷ τοῦ Κρόνου* mean, of course, *τῷ τοῦ Διὸς (τοῦ Κρόνου) ⟨ἀστέρι⟩*, and as for *τῆς Ἀφροδίτης, τοῦ Ἑρμοῦ*, I think Mr. Lorimer right in suggesting that this is 'conscious brachylogy'. *τοὺς δὲ τοῦ τῆς Ἀ.* would be a very awkward expression, and *τοὺς δὲ τοῦ τοῦ Ἐ.* even more so. Cleomedes (perhaps *c.* A.D. 100) has *τὴν Ἀφροδίτην* (i. 3, i. 11), and at ii. 7 all the five names used in this way, though he also uses the genitives. Theo Smyrnaeus, who is in this part of his work epitomizing Adrastus, always, so far as I have observed, uses the *genitives*, except possibly at 180. 6 (Hiller) *χωριστοῦ Κρόνου καὶ Διός*, where, however, *χωριστοῦ* seems to be an obvious misreading or misprint for *χωρὶς τῶν*. Cicero in his version of this very passage has *Mercurius* (with a v. l. *Mercuri*) for *ὁ τοῦ Ἑρμοῦ* (38 d 6). In the verses of Alexander quoted by Theon (139 Hiller) there is an unmetrical variant *Ἄρης* for *θρήικος Ἄρηος*, whence Hermann conjectured *θρηίκιος Ἄρης*. (Chalcidius, in his Latin version of the lines, § 72, Wrobel, p. 140, has *Armipotens*, but this proves nothing, as he also has *Cytherea* for *Κυθερείης* and *Cytherius* for *Ἑρμείαο*.) Since all the divine names except *Ἄρης* are there given in the genitive by Alexander, *Ἄρης* seems to me probably a copyist's error. In Latin (apart from the doubtful *Mercurius* of Cicero, already mentioned), the nominatives appear repeatedly side by side with the genitives in Pliny *N. H.* ii. 16 (13), e.g. 'Saturnus in Librae parte vicesima, Iupiter Cancri quinta decima, Mars Capricorni vicesima octava, Sol Arietis xxviiii, Venus Piscium xvii, Mercurius Virginis quinta decima', but further down, 'Veneris tantum stella excedit eum binis partibus, . . . ab his Mercurii stella laxissime, . . . Martis stella quatuor mediis, Iovis media et super eam duabus, Saturni duabus'.

[2] But, as we have already seen, the ascription is not beyond doubt.

38 d 3. εἰς [τὸν] τάχει μὲν . . . ἰόντας. In spite of the universal testimony of the good MSS., backed by Proclus and Stobaeus, Bt. is clearly right in omitting the *τόν*. The *τούς* of the 'vulgate' is a blundering attempt to make a sentence which will construe. Venus and Mercury are put into circles which have the same period as the sun, but not into one and the same circle. The construction is *εἰς (κύκλους) ἰόντας ἰσόδρομον ἡλίῳ κύκλον*, *κύκλον* being an accusative of the internal object after *ἰόντας*. The error of the MSS. arises naturally from a half-conscious assumption that *κύκλον* is governed by *εἰς*. Timaeus thus reckons the periods of these two planets at one year, which, seeing that the *Republic* (617 b 1) and *Epinomis* (987 b 4) also make both planets *ἰσόδρομοι* with the sun, was no doubt the accepted Pythagorean estimate, and is repeated regularly by later writers who mention the planetary periods. I need hardly say that it is far from accurate. The actual period of Venus is computed by modern astronomers at about 224 days, 16 hours, 49 minutes, that of Mercury at 87 days, 23 hours, 15 minutes. Hence the 'year' of Venus is less than five-eighths, that of Mercury less than one quarter, of our own. But probably all that the Pythagorean astronomers had to go on was that neither Venus nor Mercury ever gets so far away from the sun as he goes through the Zodiac as the other planets do. Assuming that the paths of the planets are described round the centre of the earth, or some point in its neighbourhood, this would explain why they were thought to 'tie' with the sun in his annual race. (Cf. De Morgan, *Budget of Paradoxes*, ed. 2, ii. 165.)

38 d 4. τὴν δὲ ἐναντίαν εἰληχότας αὐτῷ δύναμιν. About this passage, the meaning of which was uncertain to the ancient expositors, there has been a very bitter dispute between C. W. and A.-H. C. W., whose arguments should be studied, in the last *Part* of his pamphlet *On the Interpretation of Plato's Timaeus*, adopts very positively a wholly novel interpretation invented by Martin (*Études sur le Timée* n. 32, § 2). According to Martin, what Plato means is that Venus and Mercury revolve in a sense counter to the sun.[1] I. e. since the sun, as seen from the earth, goes through the Zodiac from W. to E. (*εἰς τὰ ἑπόμενα*), Plato means that these two planets traverse the Zodiac from E. to W. (*εἰς τὰ προηγούμενα*). This view is wholly unknown to the ancient commentators. There are two insuperable objections to it. (1) If the two planets really revolved in a sense counter to the sun, they would, of course, be revolving in the same sense as the *ἀπλανές*, but nothing is clearer than the express statement of Timaeus that the circle of the Same revolves in one sense and that of the Other in the opposite sense. How could he have said this if he really meant that two of the bands into which the circle of the Other was divided revolve in the same sense as the circle of the Same? Or if Plato had made Timaeus fall into so manifest a contradiction, how is it intelligible that no later critic ever seems to have reproached him with it? (2) The theory is inconsistent with notorious facts. If the two planets

[1] Boeckh also adopted Martin's view in *Kosmisch. System des Platon* p. 28, but without adding anything to M.'s own statement of the case for it. I am bound to say that Boeckh does not appear to me to advantage in his interpretations of the geometry and kinematics of the dialogue.

really behaved in the way suggested, they ought not to get a little way from the sun and then approach him again, vanish in his light and reappear on the other side of him. I. e. they ought not to be 'morning' and 'evening' stars at all. They ought to gain steadily on the sun until they were diametrically opposite to him, and then advance steadily in the same sense until they have gained a whole revolution on him. But it is a notorious fact that neither planet ever gets far ahead of the sun or far behind him, and this is why neither is ever seen except shortly before dawn as a 'morning' star, or shortly after sunset as an 'evening' star. What is more, Venus is the most conspicuous object in the nightly sky, after the moon, and Mercury is often clearly visible in the clear atmosphere of southern Europe. If either planet really went round the Zodiac in the reverse order, moving regularly from Aries to Pisces and from Pisces to Aquarius, the fact could be verified by the eye. I am not myself an astronomer, but no one could make me believe that Venus has a motion of this kind, for the simple reason that I can see for myself from my own front-door that Venus moves from Taurus into Gemini and so on. Am I to believe that a man whom Socrates has described as the most eminent man of science of his time could not see the same thing for himself, or was so indifferent that he never looked at Venus before formulating his astronomical theory? C. W., who treats all the doctrines of the dialogue as Plato's own, remarks that we have no right to assume that Plato could not make a blunder, and the remark is true, so far as it goes. But we may fairly refuse to believe that Plato could have made a blunder *of this nature* and that no one in antiquity should ever have discovered that he had made it, unless it could be shown that the words of Timaeus will bear no other sense. No respect for the learning of Martin or C. W. ought to blind us to the fact that their explanation of the passage is monstrous. A.-H. is quite justified in refusing to accept Martin's suggestion. Unfortunately, the attempt he makes to give a rival interpretation is confused by several bad mistakes. He falls into the error of representing Martin's guess as the traditional theory; the view which he gives, apparently as an original solution of his own, seems to be a rather unskilful combination of one or two explanations which really were put forward in antiquity, and in attempting to illustrate it by a diagram from the *Astronomy* of Arago, he has chosen one which does not correspond to the description he gives of it. C. W.'s success in exposing these weaknesses tends to conceal unduly the hopeless impossibility of his own and Martin's view. The genesis of this view, I imagine, is a misunderstanding of the words 36 d 4 *κατὰ τἀναντία ἀλλήλοις προσέταξεν ἰέναι τοὺς κύκλους*, the true explanation of which—actually given by Proclus—has been already pointed out in my note on that passage. So far, and no further, A.-H. seems to me to be in the right as against his critic. The rest of his explanation is unfortunate and apparently incoherent. He suggests that the 'contrary motion', whatever it may mean (Timaeus, by the way, does not speak of a contrary *motion* at all, but only of an *ἐναντία δύναμις*, a 'contrary tendency' or 'quality'), is attributed to the sun as well as to Mercury and Venus. But the words of the text are that the two planets have an *ἐναντία αὐτῷ* (sc. *τῷ ἡλίῳ*) *δύναμις*, so that what is

meant is manifestly some character in which Mercury and Venus *differ* from the sun. If A.-H. means that *over and above* the peculiarity in which the two planets differ from the sun, they have *also* a motion, shared by the sun, in the contrary sense to that of the extra-solar planets, he is interpolating an additional theory of which Timaeus says nothing and which is equally unnoticed in *Republic* 617 and *Epinomis* 987 b. (In the second passage we are expressly told that the ἀπλανές revolves in the opposite sense to *all* the seven planetary circles, ἐναντίος ἐκείνοις σύμπασιν πορεύεται). Further, A.-H.'s own explanation, when we come to it, is that what Timaeus is speaking of is 'retrogradation', and it is notorious that the sun has *no* motion of retrogradation. The speculation about a 'contrary motion' common to Venus, Mercury, and the sun is thus inconsistent with A.-H.'s own theory about the meaning of the ἐναντία δύναμις.

Perhaps the best way to arrive at an opinion of our own is to begin by considering what are the chief irregularities of the planetary movements known to early Greek astronomers which would naturally call for some explanation. Now there are two striking irregularities of which any attempt to analyse the planetary orbits into complexes of regular and uniform motions must take account, as e.g. the famous theory of Eudoxus did. (1) As viewed from the earth, the planets proper do not appear, like the sun, to go steadily round the ecliptic from W. to E., but to retrace their steps periodically and move for a while backwards (εἰς τὰ προηγούμενα) *against* the sense of the sun's annual orbit, then to arrest this movement of retrogradation and remain stationary, and then to resume the original advance from W. to E. They thus seem from time to time to make sinuations and loops in their path, though its *general* direction is from W. to E. (2) Apart from these facts of 'retrogradation' (ὑποποδισμός) and 'station' (στηριγμός), the planets do not proceed evenly through the median plane of the Zodiac, but make 'excursions in latitude' (πλάτος), moving sometimes to the N., sometimes to the S. of a median plane.[1] This was fancied to be true even of the sun. Both sets of facts were well known in the ancient world, and both are taken account of in the most famous astronomical theory of pre-Alexandrian times. Eudoxus required a combination of three axial rotations to explain the movements of sun and moon, one for the daily revolution, one for the periodic path through the Zodiac, and one to account for the excursions in latitude. For each of the remaining bodies he added a fourth rotation to account for retrogradation and station. These are the two outstanding and recognizable peculiarities to be accounted for, or at any rate, recognized, in a description which begins by assuming that all the 'planets' move in concentric circles. There is thus a certain antecedent likelihood that Timaeus is referring to one or both of these sets of 'appearances', though, if he is, we shall need, of course, to explain why peculiarities common to all the sun's satellites should be mentioned only in the case of the two which are 'intra-solar'. Starting

[1] I have not mentioned what might seem the most patent fact of all, the appearance of the two intra-solar planets Mercury and Venus alternately as morning and as evening stars, because, as we shall see, this is really a consequence of the facts already mentioned.

with this general presumption, we may turn to the ancient expositors to see whether we can get on the track of a sound tradition as to the meaning of the words *τὴν δὲ ἐναντίαν . . . ἑωσφόρος*, 'but having the tendency opposed to his; wherefore the sun and the star of Hermes and the morning star catch one another up and are likewise caught up by one another'. First of all, I would, however, point out that a number of the proposed explanations recorded by Chalcidius and Proclus may at once be set aside because they introduce the notions of eccentrics and epicycles, which belong to the more advanced astronomy of the Alexandrian and later ages. When the theory of concentric movements, in the form given to it by Eudoxus, of the axial rotations of spheres with a common centre, was found, even with the additional complications introduced successively by Callippus and Aristotle, inadequate to account for all the 'appearances', the notion was introduced that the proper motion of a planet is not really performed in the great circle of the Ecliptic, but in another which has its centre either on the circumference of this great circle or at some point within it other than its centre. If the former is the case, the circle in which the planet moves is called an epicycle, if the latter, an eccentric. (See the illustration of both types of hypothesis from the special case of the sun in Theon, *op. cit.*, ed. Hiller, pp. 151–172.) The centre of the epicycle was, of course, supposed to revolve with the revolution of the principal circle, or, as we should put it, to travel round the principal circle in one period while the planet itself is being carried round by (or as we should say, travels round) the epicycle in a second period. By imagining as many of such epicycles as you find necessary, or by a sufficiently adroit choice of a centre for the 'eccentric circle', you can describe the actual apparent motions very accurately, though the scheme becomes exceedingly complicated.[1] It was its complexity which made astronomers welcome with relief the return of Copernicus to the heliocentric astronomy propounded in the third century B. C. by Aristarchus of Samos and perhaps, before him, in the Platonic Academy.[2] He himself

[1] e. g. when you find yourself driven to suppose that a planet moves in an epicycle with its centre on the circumference of a circle which is itself 'eccentric'. Cf. the account of the orbit of Mercury in Proclus *Hypotypos.* v. 30 (Manit. 150) ff. Hence Milton's description of the celestial sphere :

With Centric and Eccentric scribbl'd o'er,
Cycle and Epicycle, Orb in Orb. (*P. L.* viii. 83.)

[2] Though the evidence for this is not really very strong. For a discussion of it see the chapter on Heraclides of Pontus in Heath's *Aristarchus of Samos*, and Ritter, *Platon* ii. 371–5, *Platos Gesetze, Kommentar* 238 ff. The words of Simplicius, on the strength of which Schiaparelli wishes to ascribe to Heraclides, and C. Ritter possibly to Plato himself, the Copernican theory (Simplicius in *Aristotelis Physica* B. 293^{b} 22; where the immediate authority seems to be Alexander of Aphrodisias quoting from the astronomer Geminus who in turn is quoting Posidonius—*διὸ καὶ παρελθών τις, φησὶν Ἡ. ὁ Ποντικός, [ἔλεγεν] ὅτι καὶ κινουμένης πως τῆς γῆς, τοῦ δ' ἡλίου μένοντός πως, δύναται ἡ περὶ τὸν ἥλιον φαινομένη ἀνωμαλία σῴζεσθαι*) seem to be corrupt, and no convincing correction suggests itself. At best they only tell us that some one, possibly Heraclides himself, maintained that the visible irregularities in the sun's motion might be explained by ascribing some sort of motion to the earth. There is nothing to show that the *κινουμένης πως* means having the particular motions ascribed to the earth by Aristarchus and Copernicus. I do not even feel sure that the *τις* may not conceal the name of Timaeus, and that the motion meant may not be that which we shall find Timaeus asserting.

said that he had been led to the theory by reading that the Pythagoreans believed in the movement of the earth, and the first censure passed on Galileo was for teaching 'the doctrine of the Pythagoreans, held also by Nicolaus Copernicus' (*Greek Philosophy, Thales to Plato* 5). We must, however, not attempt to explain anything in the *Timaeus* by dragging in the epicycles or eccentrics. The origin of the whole 'Ptolemaic' theory is only intelligible as an attempt to introduce a necessary correction into the Eudoxus-Aristotle machinery of the 'spheres'. The theory is said to have been first sketched by the famous third-century mathematician, Apollonius of Perga,[1] but the two chief elaborators of it were Hipparchus, in the middle of the second century B. C., and Ptolemy, at the end of the first third of the second century A. D. Dercylides, in his discussion of the myth of Er, rightly refused to admit that 'eccentrics' should be introduced into the *Republic* to account for the motions of planets, *κατὰ τὸ βάθος* (i. e. for perigee and apogee, Theon, *op. cit.*, 201. 7 *πάλιν παραιτεῖται καὶ τῆς κατὰ τὸ βάθος κινήσεως αἰτίας εἶναι τὰς ἐκκεντρότητας, περὶ δὲ κέντρον ἕν τι τὸ αὐτῆς καὶ κόσμου ἡγεῖται τοῖς κατ' οὐρανὸν φερομένοις πᾶσι τὴν κίνησιν εἶναι*). The last clause of this sentence shows that Proclus has Dercylides behind him in his reiterated denial that Plato knew anything of either epicycles or eccentrics.[2] We may now consider the various ancient interpretations. The *Timaeus Locrus* omits the clause *τὴν δὲ ἐναντίαν . . . ἑωσφόρος* altogether, but inserts a long explanation, 96 e–97 a, to the effect that the same planet appears sometimes as a morning, sometimes as an evening, star (*ὁ γὰρ αὐτὸς πόκα μὲν ἕσπερος γίγνεται, ἑπόμενος τῷ ἁλίῳ τοσοῦτον ὁκόσον μὴ ὑπὸ τᾶς αὐγᾶς αὐτῷ ἀφανισθῆμεν, πόκα δὲ ἕως, αἶκα προαγέηται τῷ ἁλίῳ καὶ προανατέλλῃ ποτ' ὄρθρον*). This looks as though the writer meant to explain that the *ἐναντία δύναμις* is the appearance of Venus and Mercury alternately as morning and as evening stars. Chalcidius discusses the matter in §§ 109–12 of his *Commentary*, giving the following account of the views known to himself. (1) 'Some' explain that the sun 'naturally' moves from E. to W., but in the course of a year describes an epicycle from W. to E., but the principal circles of the two planets as well as their epicycles are traversed from W. to E. (a view which must be rejected for the reasons given above). (2) Some think that what is meant is that Mercury and Venus appear alternately as evening and morning stars. In the former case, when they disappear at conjunction, they 'catch up' the sun, in the latter, it is the sun which 'catches up' them. (This is, in fact, the explanation also hinted at by *Timaeus Locrus*, loc. cit.) (3) Heraclides of Pontus (a personal disciple of Plato) urged that Venus appears now 'above', now 'below' the sun, making an excursion of 50° in either

[1] Proclus *Hypotypos*. v. 79 (ed. Manitius, p. 174).

[2] Proclus *in Timaeum* (Diehl) iii. 65 *ὁ δέ γε θεῖος Ἰάμβλιχος οὔτε τὰς τῶν ἐπικύκλων παρεισκυκλήσεις ἀποδέχεται ὡς μεμηχανημένας καὶ ἀλλοτρίως τοῦ Πλάτωνος εἰσαγομένας*; *in Rempubl.* ii. 229 (Kroll) *καὶ μὴν καὶ τὸ τοὺς ἐπικύκλους ὑποτίθεσθαι παντάπασιν ἄτοπον κτλ.*; *Hypotypos*. vii. 55–7 (where Proclus is giving his own verdict on the Ptolemaic system) *πρὸς δὲ αὖ τούτοις καὶ ἠυτοματισμένη φαίνεται τῶν μεμηχανημένων τούτων ὑποθέσεων ἡ παράδοσις . . . τίνα τὰ αἴτια, τὰ ὡς ἀληθῶς γε αἴτια λέγω, καὶ ἃ μάλιστα ψυχὴ κατιδοῦσα πέπαυται πάσης ὠδῖνος, οὐδαμῶς λέγουσιν, κτλ.* (Proclus thus, like Newton, demands *causae verae* in astronomy.)

sense. She is furthest E. of the sun when she appears as an evening, furthest W. when she appears as a morning, star. This, to be sure, is simply a more precise statement of the view which has already been given as (2). The name of Heraclides carries weight from his personal association with Plato. (Chalcidius never mentions any other early Academic expositors by name at all, and this is a fair reason for holding that he took his references to their views at second-hand.) Proclus gives it briefly as his opinion that the astronomical facts Plato has in mind are those of 'advance' on the sun, 'station' and 'retrogradation' (προποδισμός, στηριγμός, ὑποποδισμός, *op. cit.* iii. 68). This is identical with the interpretation Chalcidius ascribes to Heraclides of Pontus and with that of the *Timaeus Locrus*. It seems to me, therefore, that as the interpretation really has a tradition behind it which goes back to the first generation of the Academy, we should accept it. The ἐναντία δύναμις will mean, as A.-H. says—though he was unlucky in his choice of a diagram to illustrate his statement—the tendency of the two planets to 'retrace their steps' periodically, which is, of course, not exhibited by the sun, who keeps steadily on. But if this is the correct interpretation, a further question arises at once. Why is this tendency only attributed to these two planets? All the planets exhibit 'retrogradation', and it is Mars which has the greatest arc of retrogradation of them all. (The fact was well known in the age of Socrates if we may accept Bt.'s view that at *Republic* 617 b 3 the words μάλιστα τῶν ἄλλων, which are given by Theo Smyrnaeus 145. 19 after ἐπανακυκλούμενον, are really a line of the text which has accidentally dropped out in the source of our extant MSS.[1]) The explanation seems to me simple, and indicated by the remarks of Heraclides. Venus and Mercury, the intra-solar planets, do not get so far away from the sun as the extra-solar planets. The maximum distance for Venus was reckoned, as we have seen, at 50° E. or W., that for Mercury at 20° N. or S. (Chalcidius *Comment.* § 70, p. 138 Wrobel). Hence these two planets are never e. g. in diametrical opposition to the sun. They only appear either very shortly before dawn or very shortly after sunset, and so are his *satellites* in a very special sense. It is the very way in which they seem to dog his steps so closely which makes behaviour that passes unremarked by Timaeus in the other planets call for a word of notice in their case. Or, to put the point in a different way, there are two different aspects under which you can look at 'retrogradation' and the connected appearances. You can look at them relatively to the planets' course through the Zodiac; then what you will note will be the planets' periodical 'moving back' from a sign to the one 'before' it. Or, in the case of the two planets which are nearest to the sun and within the earth's orbit, you can look at the same facts relatively to the planets' behaviour to the sun, as an alternate 'gaining on' the sun and 'falling behind' him. It is from the second point of view that T. is looking at the matter here. (Even if neither planet ever got so far in advance of the sun that in returning to conjunction with him it moved back out of a sign of the Zodiac into the one before, it would still be possible for the planet

[1] *EGPh.*[3] 304 n. 1. I certainly do not believe that Theon or his authority Dercylides would have added the words *de suo*.

alternately to be 'caught' by the sun and to 'catch him'.[1]) Of course, this statement about the *ἐναντία δύναμις* is a mere record of the appearances; it does not in any way account for them. Timaeus does not tell us *why* the two planets and the sun in turns gain on one another. No explanation could be offered by a man who assumed all three to be revolving with uniform velocities in the same sense and with the same period in concentric circular orbits. Eudoxus, as we shall see, put forward in the Academy itself a theory expressly designed to account for these 'anomalies' as well as others, but Timaeus takes no account of the theory. He could not be made to show any knowledge of it without a flagrant 'anachronism'.

I have not raised the question of the soundness of our text as it stands. It might be thought that the *τήν* creates a difficulty. Ought we not to have simply *ἐναντίαν δύναμιν* without the article? Cicero translates the phrase 'vim *quamdam* contrariam'. Hence Professor Shorey's suggestion to read *πῇ* for *τήν*. I do not know that Cicero's *quamdam* is evidence of anything. His translation is by no means painfully accurate in small points, and it is quite possible that he added the *quamdam* on his own account. As Martin says, he may have introduced the vagueness because he did not himself understand precisely what Timaeus means. Or it may be meant as a mere literary grace. On the other hand ΠΗΙ is sufficiently like ΤΗΝ to make the conjecture palaeographically a good one. But is it absolutely necessary? We may find Timaeus's language puzzling at times merely because we know so little about the phraseology of Pythagorean astronomers in the later fifth century. The article may mean 'the ⟨familiar⟩ *ἐναντία δύναμις*'.

38 d 6–e 1. τὰ δ' ἄλλα . . . παράσχοι. Presumably this reluctance to enter on an irrelevant discussion of further details means that the fifth-century Pythagorean astronomers had said relatively little about the extra-solar planets. The suggestion of a fuller explanation at a 'fitting opportunity' only means as much as our own colloquial references to 'another time', viz., that the thing is not going to be done now.

38 e 5. ζῷα. The bodies became *ζῷα* when conjoined with *ψυχαί*. It is nowhere said whether the planets have *ψυχαί* of their own or are simply animated by the one cosmic *ψυχή*. Proclus always insists on the former view, but we have no right to be too sure that Timaeus had even asked himself the question. To answer it, as it seems to me, we should need to know whether the planets, like the stars, are supposed to have axial rotations of their own. If they are, then there must be *ψυχαί* of the planets themselves to cause these rotations. Proclus assumes that the planets have such axial rotations.

39 a 1. διὰ τῆς ταὐτοῦ φορᾶς ἰούσης τε καὶ κρατουμένης. This is the reading of all the best MSS., and was obviously in their common source.

[1] But even in this case, the appearances include retrograde motion of the planet. Venus e.g. does not appear after getting ahead of the sun to stand still until she is caught up, but to stand still and then travel back to meet the sun. Only this side of the transaction would be still more apparent in the case of the extra-solar planets, which travel as far as 180° from the sun in the Zodiac, and are then said to be in 'diametrical' opposition to him.

But it raises a difficulty which seems insuperable. Timaeus means to say that the circles of the Other were 'warped' or 'twisted' by the combination of their movement with that of the Same, which is in a different plane. But how can the revolution of the Same be said to be 'overpowered' in this process, when we have been told expressly that the *κράτος* was given to the undivided circle of the Same? Cicero renders the clause '(in eiusdem naturae motum incurrentia) in eaque haerentia atque impedita'. This implies that he read accusatives for the genitives *ἰούσης* and *κρατουμένης*. His words might represent either *ἰόντα τε καὶ κρατούμενα* or *ἰοῦσάν τε καὶ κρατουμένην*. Chalcidius has 'motus obliquus per directum eiusdem naturae motum uertens semet utpote constrictus', which manifestly renders *διὰ τῆς ταὐτοῦ φορᾶς ἰοῦσάν τε καὶ κρατουμένην*. The comments of Proclus do not seem to me to show with certainty what text he had before him.[1] My own opinion on this evidence is that *ἰοῦσάν τε καὶ κρατουμένην* was the oldest text, and that the genitives have got into our good MSS. by an easy false assimilation to the case of *φορᾶς*. (The accusatives in later MSS. probably do not represent any vestige of the true tradition, but are a deliberate and obvious conjectural correction). I would therefore restore the accusatives on the evidence of Cicero and Chalcidius. Hermann, the Zürich editors, and Bt. print the genitives, but I can hardly believe they suppose them to make sense. Presumably they do not feel sure what the precise original text was, since *ἰόντα τε καὶ κρατούμενα* would also give a correct sentence with the requisite sense and *might* be what Cicero had before him. It should be noted that the Latin version of Ficinus, which sometimes affords evidence as to the readings of MSS. no longer extant, has 'secundum alterius diversaeque naturae obliquam agitationem eiusdem ipsius agitationi subiectam', which, at any rate, seems to imply *κρατουμένην*. The *διά* must mean 'through' in the local sense, not 'by the agency of', and this is a further objection to the genitives *ἰούσης* and *κρατουμένης*. Even apart from the difficulty of *κρατουμένης*, the sense of the MSS. text could only be that the circle of the Other is oblique to that of the Same 'in virtue of the movement of the Same'. But it is not true that the obliquity of the Ecliptic in the theory of Timaeus is an effect of the diurnal revolution. There is no question of offering any explanation of its obliquity. The Demiurge is just supposed to have inclined the circles to one another and that is the end of the matter. We are dealing with an 'ultimate collocation'.

39 a 2–3. *τὸ μὲν μείζονα . . . περιῄειν.* Note the complicated and artificial character of the construction. The subject of *περιῄειν*, like that of *ἐγενήθη* and *ἔμαθεν*, is the *σώματα* of 38 e 5; this is broken up by 'partitive apposition' in a 2 into *τὸ μέν* and *τὸ δέ*, then in a 3 *τὰ μέν* and *τὰ δέ* are substituted for these singulars and the whole collective subject, the *σώματα*, resumed as subject to *περιῄειν*. Tr. 'and in virtue of the

[1] He says (Diehl iii. 74) *τοιαύτη δὲ οὖσα ἡ θατέρου περιφορὰ διὰ τῆς ταὐτοῦ τε εἶσι καὶ κρατεῖται*, which implies the reading *ἰοῦσαν . . . κρατουμένην*, and he assumes all through his remarks on the passage that the *φορὰ τοῦ θατέρου κρατεῖται*. It seems to me that he had the accusatives before him, but the MSS. are divided about the text of the lemma, and his latest editor, Diehl, thinks the testimony there in favour of the genitives.

movement of the Other, which is oblique, while it moves through the motion of the Same and is controlled by it, some of the bodies traversed a greater, some a smaller orbit, those which traversed the smaller revolving faster, those which traversed the greater, more slowly'. The words make it clear that Timaeus regards the moon as the swiftest, Saturn as the slowest, planet, and thus show beyond dispute what has been assumed in earlier notes, that by the *τάχη* of the circles he means simply the 'periodic times' of the planets, not their 'velocities in their orbits'. It is roughly true that the nearer a planet is to the centre of the system the greater is its velocity in its orbit, but Timaeus could not know the real reason for this. Saturn, from his point of view, is the slowest planet simply because Saturn takes so long to get round his orbit; he does not allow for the much greater distance which Saturn has to go.

39 a 4–5. **τῇ δὴ ταὐτοῦ . . . καταλαμβάνεσθαι.** The meaning has already been explained. If we suppose all the celestial revolutions to be performed in the *same* sense, we shall have to say that Saturn is the swiftest planet because he most nearly keeps pace with the *ἀπλανές*, the moon the slowest, because she falls most behind. Hence we shall think of the moon as caught and passed in the race by Saturn. But the recognition that the planets move in their orbits against the *ἀπλανές* requires us to correct our language. Saturn will be the slowest of the planets because the *ἀπλανές* takes longest to pass him, and so we shall have to say that really it is Saturn who is caught and passed by the moon.

39 a 6–b 2. **πάντας γὰρ . . . ἀπέφαινεν.** A.-H. goes astray about the grammar of the clause. He is, of course, right in saying that the words *διὰ τὸ διχῇ . . . ἅμα προϊέναι* go with *στρέφουσα ἕλικα* only, and not with the main enunciation. (Even if all the revolutions went on in the *same* plane, it would still be possible, as we have just seen, to 'call the swiftest the slowest'. Indeed, you *might* make the mistake in the special case of the 'swiftest' and 'slowest' of all, as all the geocentric systems of astronomy did by attributing a period of 24 hours to the *ἀπλανές*, and no motion at all to the earth, though this is not what Timaeus has in mind.[1]) But A.-H. makes a nonreal difficulty about the subject of *προϊέναι*, which he supposes, by an extraordinary licence, to be *τὴν ταὐτοῦ φοράν* and *τὴν θατέρου φοράν* jointly. It is really an 'understood' subject, which may either be *τὰ περιόντα* or *τοὺς κύκλους*; Stallbaum, as so often, is right about the grammar, translating 'orbes eorum in gyrum agitans eo quod

[1] Proclus explains the connexion of thought quite correctly (Diehl iii. 78–9) *οὔτε γὰρ τοῦτο αἴτιον τῆς ἕλικος, τό δύο φέρεσθαι φορὰς τῶν πλανήτων ἕκαστον, ἀλλὰ τὸ ἐπὶ λοξοῦ κινεῖσθαι κύκλου πρὸς τὸν ἰσημερινόν . . . μήποτε οὖν τὸ μὲν διχῇ κατὰ τἀναντία προϊέναι τοιοῦτόν ἐστιν, οὐ μόνον τὸ ἅμα κινεῖσθαι πρὸς ἀνατολὰς καὶ δύσεις, ἀλλὰ καὶ κατὰ πλάτος καὶ κατὰ βάθος . . . αὗται γὰρ αἱ δύο κινήσεις τὴν ἕλικα ποιοῦσι μετὰ τῆς τοῦ παντὸς φορᾶς.* I.e. he rightly holds that *διχῇ* refers to the fact that the two movements are in different planes. I cannot, however, believe that any reference to movement *κατὰ βάθος* is intended. Timaeus nowhere else takes any notice of perigee and apogee, and to find it here we have to suppose that *διχῇ* means 'in two planes *besides* that of the diurnal motion'. This, I think, is incredible. Chalcidius (*Comment.* § 116, ed. Wrobel 181) seems mistakenly to suppose that a spiral of Archimedes is what is meant by the *ἕλιξ*. At least, his account of the way a spiral is produced only applies to that curve.

dupliciter contrario simul motu procedebant'. ἕλικα is adverbial accusative, 'twisting corkscrew-wise', 'giving a screw to'. Properly ἕλιξ is an adjective = 'twisty', as in Homer's ἕλικας βοῦς, which seems to refer to the 'rolling' gait of the animal. As a noun it means anything curly or twisty, particularly the curling tendrils of the vine, the coils of a serpent, various mechanical screws. (See L. and S., *sub. voc.*) So στρέφειν ἕλικα = 'to give a curl to'. We must not think of a curve all in one plane, like the familiar 'watchspring' coiling curve known as the 'spiral of Archimedes', since the two components of the 'curl', the revolutions of the Same and of the Other, are in different planes. We must think of a 'corkscrewing' motion. ἕλικες are mentioned more than once by Aristotle as 'mixed' paths resulting from a combination of the two ultimately simple motions, rectilinear translation and circular revolution, i. e. combinations of a twirl and a slide. This is exactly what a corkscrew motion is.

The phrase about the corkscrew raises a question of which the editors do not take sufficient account. It is true that a spectator placed outside all the motions of the solar system and regarding himself as at rest, would see the movements of the planets as spirals; with respect to axes of co-ordinates 'at rest in Newtonian space' or 'at rest relatively to the ether'—if these phrases mean anything, which is doubtful—the motions are spiral. But is this all that Timaeus means? I think it is not; the spiral character of the movements is not really needed to explain why we come to regard the swiftest planet as the slowest. The movement is a spiral not because it is composite but because the two components are in planes inclined to one another. Hence I think T. must be intending to refer not to the motions of the system in 'absolute' or 'Newtonian' space, which we, of course, do not see, but to something which we do see. He means that the 'apparent' motions of the sun and planets, as viewed by a spectator on the earth, are corkscrews. Now this is in fact partly true. The planets do not appear to an observer on the earth to describe an exact circle in the median plane of the Ecliptic in their various periods. They seem to make excursions 'sideways' or 'in latitude' (κατὰ πλάτος) from the true circular path through the 'middle of the Zodiac'. The ancients strangely extended this conception to the case of the sun. On the other hand, Eudoxus seems to have deliberately ignored the ἀνωμαλία of the seasons, though the fact had been discovered in the fifth century. (See Heath *Aristarchus of Samos* pp. 198–200.) It is not clear whether Timaeus means to allude to it here or not. The most natural interpretation of his words is perhaps that he, like others, assumes the sun, as well as the other 'planets', to have a motion in 'latitude'. The paths of the outer planets are still more complicated corkscrews. Now we know that these 'irregularities' were a special object of interest to Plato and his pupils, though it would be absurd to suppose that they discovered the facts for the first time. In fact, it was just these irregularities (ἀνωμαλίαι) which provided the starting-point for the famous astronomical theory of Eudoxus, adopted and depraved by Aristotle. Our fullest information about this matter comes from the commentary of the Neo-Platonist Simplicius on Aristotle *de Caelo*, 293^{b}24 ff., with which

may be compared the briefer account of Theo Smyrnaeus (ed. Hiller, pp. 178–81). Simplicius tells us his authorities for what he says. He drew from a compendium by Sosigenes, a Peripatetic of the second century A. D., but Sosigenes was repeating the statements of the eminent mathematician and associate of Aristotle, Eudemus of Rhodes, who wrote the first history of Greek mathematics. So that, though Simplicius lived in the sixth century A. D. (he was one of the seven philosophers who migrated to Persia after the closing of the schools by Justinian in 529), our information comes from an exceptionally competent fellow-student of Aristotle, and is thoroughly trustworthy. According to Eudemus, Plato gave the impulse to the whole theory by propounding in the Academy as a subject for research (*πρόβλημα*) the question 'what are the simplest assumptions on which the apparent motions of the planets can be explained as resultants of the composition of perfectly uniform simple motions?' (*τίνων ὑποτεθεισῶν ὁμαλῶν καὶ τεταγμένων κινήσεων διασωθῇ τὰ περὶ τῆς κινήσεως τῶν πλανωμένων φαινόμενα*;). Eudoxus, the eminent mathematician and philosopher, who had transferred himself and his pupils from Cyzicus to Athens to co-operate with the Academy, and is otherwise interesting as the author of the doctrine of proportion followed in Euclid *Elements* v, the inventor of the method of Exhaustion, out of which the Integral Calculus was to be developed, and the founder of philosophical Hedonism, offered a solution which Eudemus regarded as the first complete theory of planetary motions propounded by any Greek (*καὶ πρῶτος τῶν Ἑλλήνων Εὔδοξος ὁ Κνίδιος, ὡς Εὔδημος . . . ἀπεμνημόνευσεν . . . ἅψασθαι λέγεται τῶν τοιούτων ὑποθέσεων*). He proposed to analyse the movements of each planet into a combination of rotations of concentric spheres, the common centre of all the spheres being that of the earth, which is also the centre of the universe. (These spheres, as we shall see directly, were supposed to be purely 'ideal' or 'mathematical', not to be actual physical globes. It was Aristotle's unlucky idea to turn them into physical 'bodies', and so to bring into philosophy the fatal doctrine that the 'heavens' are made of a special kind of stuff with peculiar dynamics of its own.)

For our purposes it will be sufficient to describe exactly the analysis Eudoxus gave of the sun's motion. In dealing with Plato's problem he had to take three things into account, (*a*) the sun's daily movement from E. to W., (*b*) his annual movement through the Zodiac from W. to E., (*c*) the irregularities just mentioned in this annual movement. Accordingly he assumed *three* 'spheres' to account for the behaviour of the sun. The outermost is supposed to rotate on the same axis as the whole universe, an axis perpendicular to the plane of the sidereal Equator. (Thus the movement of the 'Same' is repeated by it, just as Timaeus says that this movement 'prevails over' all others.) Its period is 24 hours, and the sense of its rotation is from E. through W. to E. again. This accounts for the alternation of day and night. The middle sphere is thought of as rotating in the period of a solar year from W. through E. to W. on an axis perpendicular to the median plane of the Zodiac. (This is the proper movement of the 'circle of the sun' as already described by Timaeus.) The innermost of the three spheres is meant to account for

the ἀνωμαλία or irregularity of the sun's apparent annual movement. It also rotates from W. through E. to W. Its axis is to be thought of as 'perpendicular to the plane of an oblique great circle which the centre of the sun appears to trace out as the sun moves round with the sphere in which it is fastened'. (The 'sphere in which the sun is fastened', of course, contributes nothing to the mechanics of the system. It is merely turned round by the combined motion of the other three.) This third sphere 'falls behind' more slowly than the second, and has a different axis, and thus the sun's irregularities (his supposed 'excursions in latitude') are accounted for by the differences of axis and rapidity of rotation between the second and third spheres. Thus, if we suppose that there are three revolving spheres for the sun (besides the inert sphere in which he is set), the sun's motions are resolved into a combination of three uniform axial rotations. For the rest, the theory ascribes three revolving spheres to the moon and four to each of the other five 'planets'. In each case the outermost sphere has the same axis as the universe and a period of 24 hours, the second has an axis perpendicular to the median plane of the Zodiac and the period which is that of one complete revolution of the planet through the Zodiac. The third or third and fourth spheres are provided with such axes and periods as will account for the known 'irregularities' of the planets in question. Thus Eudoxus required twenty-six revolving spheres for the seven 'planets', besides one for the stars, twenty-seven in all. Seven more were added by his associate Callippus, one each for Venus, Mercury, and Mars, and two apiece for the sun and moon, thus bringing up the total number required for the whole mechanism of the heavens to thirty-four (Aristotle *Met.* Λ. 1073^{b} 22). According to Simplicius, Callippus himself left no statement of the reasons for these additions, but Eudemus explained the point briefly thus, 'Callippus says that if the times between the solstices and equinoxes differ as much as Meton and Euctemon supposed [i. e. if the inequality of the seasons is as great as these observers computed], three spheres apiece for sun and moon are not enough to save the appearances'. As for the one sphere apiece added to those of Venus, Mercury, and Mars, Simplicius only says that Eudemus 'explained the reason for the addition clearly and succinctly'.[1]

Now comes in the amazing depravation of the theory by Aristotle. He raises his difficulty himself in *Met.* Λ. 8. 1073^{b}—1074^{a}. It is this. Suppose Saturn, let us say, has the four motions ascribed to him by Eudoxus. The outermost sphere of Jupiter lies inside the innermost sphere of Saturn. Consequently, the very complicated motion of Saturn will be communicated to the outermost sphere of Jupiter. The poles of this sphere will lie on the innermost sphere of Saturn, with the result that

[1] For a full account of the theory of Eudoxus see Sir T. L. Heath *Aristarchus of Samos* c. xvi, pp. 190–211, where it is pointed out (after Ideler) that Simplicius, and apparently Aristotle in his brief allusion (*Met.* Λ. 1073^{b} 17 ff.), have made a mistake about the case of the sun and moon. In their case, though not in that of the planets proper, it must have been the 'third' or innermost sphere, not, as S. says, the second, which has the function of accounting for the 'anomalies'. For Callippus and Aristotle see Heath *op. cit.* pp. 212–24; Ross, *Aristotle's Metaphysics* ii. 384–94.

the axis of Jupiter's outermost sphere will be oblique to that of the universe and be moving in a very complicated way. But to account for the apparent diurnal return of Jupiter to approximately the same place in the sky, the axis of this sphere ought to be the same as that of the universe, and its period ought to be 24 hours. And the same reasoning will apply to other planets. Consequently, Aristotle held that the theory must be complicated still further. If Saturn has four spheres, with the axes and periods of rotation assigned by Eudoxus, we must interpolate between the innermost sphere of Saturn and the outermost of Jupiter, three more spheres with the same axes and periods as the second, third, and fourth of Saturn, but in the reverse order and with a contrary sense of rotation, so as to cancel out all the 'proper' motions of Saturn, and leave only the diurnal rotation on the axis of the universe standing for the outermost of Jupiter's revolving spheres. The same considerations apply to every planet except the moon. The moon has no planet below her, and her motion does not need to be cancelled out. Hence, by starting with the additions of Callippus and intercalating the cancelling spheres on his own account, Aristotle gets seven spheres for Saturn, seven for Jupiter, nine for Mars, nine for Mercury, nine for Venus, ten for the sun, five for the moon. This makes up the total of fifty-five revolving spheres for the planets, *plus* one for the stars given in the *Metaphysics*.[1] Aristotle's whole difficulty arises from his assumption that the spheres of Eudoxus are actual *bodies*; the fact that Eudoxus and Callippus saw no need to introduce 'compensatory' spheres of itself proves that they did not make this elementary blunder. Further, the theory, whether in Eudoxus's form or in Aristotle's, did not really 'save' all the appearances, even as they were known in the fourth century B. C. Simplicius, or his authority Sosigenes, observes that it is not explained why the distance of a planet from the earth is variable, nor yet why solar eclipses are sometimes total and sometimes annular. Eudoxus and Aristotle, says Simplicius, blinked these facts from excessive devotion to the view that all the motions are 'round the centre' (in fact, from an exaggerated geocentricism). It was precisely these difficulties which led later astronomers like Hipparchus and Ptolemy to drop the whole scheme of the concentric spheres and replace it by eccentrics and epicycles. Simplicius argues earnestly that it is no disloyalty to Aristotle to accept the Ptolemaic astronomy, though he allows that even this does not wholly 'save the appearances', since Aristotle and Eudoxus, through no fault of their own, had to make their theories in ignorance of the long records of observations made at Babylon, which were first made accessible to Greek astronomers by Alexander's conquests. Proclus, in the preceding century, had shown much greater independence of mind. He fully understands the character of what we call a 'scientific hypothesis', and is clear on the point that the astronomy of Ptolemy as much as that of Eudoxus is simply a mathematical analysis. Hence he insists that

[1] But there is some difficulty about making the numbers given in the text of the *Metaphysics* tally with the total and fit the assumptions on which the scheme is based. See the notes *ad loc.* in Bonitz's and Ross's editions of the *Metaphysics*. We seem to be forced to choose between emendation and supposing Aristotle to have done a simple sum wrong.

eccentrics and epicycles are just as much 'useful fictions' as the revolving spheres, and is emphatic on two points of first-rate importance, (1) that the planetary paths are actually described by the free motion of the planets themselves; it is merely a convenient fiction to represent the planets as carried round by revolving circles or rotating spheres; (2) that the 'anomalies' are real facts, not delusive 'appearances'; it is the fact that no actual planetary movement is absolutely uniform; such uniformity may exist in mathematical theory, but not in physical fact. This sound understanding of the real character of mathematical *ὑποθέσεις* is a much more important thing than the occasional whimsicality which led Proclus e. g. to defend the Platonic order of the planets and to call in doubt Hipparchus's great discovery of the precession of the equinoxes.

It naturally becomes a question which ought to be carefully considered whether Plato, when he wrote the *Timaeus*, knew the theory of Eudoxus, and whether there is any allusion to it in our dialogue or elsewhere in Plato's works. Unfortunately, we do not know the date at which Eudoxus propounded the theory, but we do know that Eudemus, an associate of Aristotle, represented the theory as propounded in solution of a problem proposed by Plato to the Academy, and as something absolutely original. The phrase of Eudemus that Eudoxus was *πρῶτος τῶν Ἑλλήνων* to produce such a theory clearly must mean that the main idea of the whole system, the scheme of concentric rotating spheres, was something quite novel and not a mere development of pre-Academic ideas. It follows that, since the Academy must already have been organized and become widely known before an eminent scientific man would be likely to transport his whole school from Cyzicus to Athens, to have the benefit of co-operation with the new institution, we cannot expect to find any traces of the system in Platonic dialogues written before or very immediately after the foundation of the Academy. This means that we cannot expect to find such traces in the *Republic* or any still earlier work. And, in fact, we do not find them. In the myth of Er, the only part of Plato's writings, apart from those of his old age, where the planetary movements are described, we hear only of circular orbits, compared with the lips of a set of 'whorls' one inside another, and of the contrariety of sense between the revolution of the outermost circle and those of the others. Clearly we are not entitled to read the very different machinery of 'spheres into this description, which, in fact, recalls the second part of the poem of Parmenides, or to find any allusion to more than the 'two' motions which are expressly specified. With the *Timaeus* and the *Laws* matters stand differently, as no one doubts that they are, at any rate, productions of Plato's old age. The precise dates of the birth and death of Eudoxus are not known, but Apollodorus (i. e. Eratosthenes, D. L. viii. 90), placed his *floruit* in Olymp. 103 (B. C. 368–4), and this means that he was supposed to be born about 408–4 B. C., a date which fits in well with what is recorded of his relations with Plato and Plato's friends, Archytas and the Sicilian physician Philistion. Diogenes adds that he died prematurely at the age of 52–3. This would mean that his death fell somewhere about 356–2. (It is in favour of the truth of the statement that it is given in precise and

not in round numbers.) Thus the belief of the chronologists clearly was that Eudoxus died some years before Plato, and this is all the more likely that in the discussion about the number of 'spheres' in *Met.* Λ. c. 8, Aristotle speaks throughout not only of Eudoxus but of Callippus in the past tense in a way which implies that they had been dead some time. We may therefore fairly assume that the solution given to Plato's problem by Eudoxus was given in Plato's lifetime, and that Plato was consequently acquainted with it. It would therefore be quite possible that Plato, who, as we see from the state of the text of the *Laws*, left that work at least unrevised at death, should make some allusion to the theory in his very latest writings.[1] In the *Laws* and *Epinomis* it seems to me that we can find such references. At *Laws* vii. 822 a, as we have seen, Plato definitely refuses to accept for himself the theory that a planet's path through the Zodiac is really a resultant of several motions, the doctrine common to Timaeus and Eudoxus. His actual words are, *τὴν αὐτὴν γὰρ αὐτῶν ὁδὸν ἕκαστον καὶ οὐ πολλὰς ἀλλὰ μίαν ἀεὶ κύκλῳ διεξέρχεται, φαίνεται δὲ πολλὰς φερόμενον*, i. e. all the apparent motions but one are merely 'apparent', they are not real components of a real complex path. The words have already been quoted in proof that the theory of the 'double motion' given in the *Timaeus* is not that which satisfied Plato himself. But the reference to this Pythagorean doctrine can hardly exhaust Plato's meaning. If he had only this doctrine in view, it would be more natural to deny that a planet has *two* motions, especially as it was the common view that *three* is the smallest number which can properly be called *πολλά*, *two* being *ἄμφω* or *ἀμφότερα*. (This is what is meant by the Pythagorean saying quoted by Aristotle De Caelo A. 268ª 11, *τὸ πᾶν καὶ τὰ πάντα τοῖς τρισὶν ὥρισται· τελευτὴ γὰρ καὶ μέσον καὶ ἀρχὴ τὸν ἀριθμὸν ἔχει τὸν τοῦ παντός, ταῦτα δὲ τὸν τῆς τριάδος*. We cannot say 'all' of any collection less than a triplet, for whatever is 'all' has 'beginning, middle, and end'. For a similar reason at *Parmenides* 137 d, the proof that the 'One' cannot be 'many' turns on the point that if it really is *one*, it can have neither beginning, middle, nor end, and *per contra* at 143 d ff., where the object is to argue that the 'One' is 'many', this conclusion is not drawn directly from the proof that it is, at any rate,

[1] I might have added that the well-known reference to the character and reputation of Eudoxus in the *Ethics* (*E. N.* 1172ᵇ 15 *ἐπιστεύοντο δ' οἱ λόγοι διὰ τὴν τοῦ ἤθους ἀρετὴν μᾶλλον ἢ δι' αὐτούς, διαφερόντως γὰρ ἐδόκει σώφρων εἶναι*), definitely implies that he belongs to the past. Aristotle's zeal for the hypothesis of Eudoxus, as well as the disproportionate prominence given in *Met.* A. 991ª 15–19 = M. 1079ᵇ 20–3 to his amateurish attempt to explain *μέθεξις*, is also most intelligible if we suppose that he was particularly prominent in the Academy, precisely owing to the absence of Plato at Syracuse, when Aristotle first entered it, i. e. *c.* 367. As a conjecture, I would suggest that the propounding of the astronomical problem by Plato and the solution of Eudoxus most likely belong to the time just before Plato's Syracusan voyage, or else to the years immediately following Plato's return. As a conjecture, and nothing more, I suggest also that the reason for the selection of Ol. 103 for the *floruit* of Eudoxus was that the second year of the Olympiad is the date of Plato's important visit to Syracuse, and that it was known that in Plato's absence Eudoxus was the most prominent member of the Academy. We may be fairly sure that for some years after Plato's return to Athens his relations with Sicilian politics continued to interfere with his activity as head of the school. I should conjecture that the promulgation of the astronomical theory of Eudoxus belongs to this period.

'two'; it is thought necessary to argue that if it is 'two', it can also be shown, since it is both 'one' and 'two', to be 'three'.) The οὐ πολλάς of the Athenian's protest thus seems to me to include a perfectly unmistakable side allusion to Eudoxus, who credited the orbits of sun and moon with three components, and those of the other planets with four. There seems again to be a similar allusion in the remark of *Epinomis* 987 b 9, that the 'eighth circle' does not carry the other seven round with it, ὡς γε ἀνθρώποις φαίνοιτ' ἂν ὀλίγα τούτων εἰδόσιν. *All* theories of a 'composite' motion for the planets fall under this condemnation, but we can hardly suppose that Plato's little sarcasm about the 'amateurs' in astronomy is meant for persons who were in their prime the best part of a century before it was written. Its mark must clearly be some conporaries who held the theory of a 'composite' motion, and we can hardly be wrong in supposing that the reference is, not indeed to Eudoxus, who was most likely dead when the words were written, and could hardly have been treated so cavalierly even if he had been alive, but to younger members of the Academy who adopted his view with more zeal than knowledge. It is by no means impossible that it is Aristotle, with his quaintly materialistic interpretation of the 'spheres' and his consequent puzzle about the compensatory devices required to make the system work, who is really in Plato's mind. That Plato was acquainted with the scheme of Eudoxus, then, at the time when he wrote the *Timaeus*, seems to me reasonably certain. It is quite another question whether there are any allusions to it in the dialogue. Since Eudemus laid special stress on the *originality* of the scheme of Eudoxus, to make a fifth-century Pythagorean expound it at a date before its author's birth would involve singular violation of historical probability. And in fact, the one feature of the Eudoxian scheme which appears in that of Timaeus, the opposition of sense between the movements of the planets and that of the ἀπλανές, occurs also in the myth of Er. It is thus no invention of Eudoxus, but a genuine fifth-century doctrine, and may even, as we have seen, be that of Pythagoras himself. Though the supposed *facts* about the sun's irregular habits, to explain which Eudoxus gave him his 'third sphere', seem to be hinted at in the words στρέφουσα ἕλικα, Timaeus offers no theoretical explanation of them, any more than he does of the station, retrogradation, &c. of the planets mentioned at 40 c–d. He merely names the facts, and no one supposes that Eudoxus discovered *them* for the first time. (In fact, Eudemus expressly refers to the observations of Meton in the Periclean age on the 'solar anomaly', and, according to Theo Smyrnaeus 198. 16, he also recorded that the mere fact of the inequality of the seasons was known from the time of Thales.[1] If

[1] Theon *op. cit.* 198. 14 Εὔδημος ἱστορεῖ ἐν ταῖς Ἀστρολογίαις ὅτι Οἰνοπίδης εὗρε πρῶτος τὴν τοῦ ζῳδιακοῦ διάζωσιν καὶ τὴν τοῦ μεγάλου ἐνιαυτοῦ περίστασιν· Θαλῆς δὲ ἡλίου ἔκλειψιν καὶ τὴν κατὰ τὰς τροπὰς αὐτοῦ περίοδον, ὡς οὐκ ἴσῃ ἀεὶ συμβαίνει. The word διάζωσιν, marked as corrupt by Diels in the citation of this passage under the caption *Oenopides* in *Fr. d. Vors.*[3] i, seems to me probably sound. The astronomer Cleostratus of Tenedos was generally held to have first satisfactorily marked out the Zodiac into constellations (Scholium to Euripides *Rhesus* 528, Pliny *N. H.* ii. 31, *Fr. d. Vors.*[3] ii. 1. pp. 197–8), but the notices are quite compatible with the view that the division finally accepted was not worked out all at once. In its existing form it may be due to Oenopides, as Eudemus appears to have said.

Timaeus had given the sun and planets a *third* motion to account for these irregularities we might fairly have seen an allusion to the scheme of Eudoxus, apparently the first which attempted to 'explain' the 'irregularities' at all. But this is just what he does not do. He specifies only two components of the sun's motion, the daily and the annual. The fact that there are 'appearances' which the two together will not 'save' is mentioned, but left entirely unexplained, unless we are to find a hint of the explanation in what is said at 40 b 8 about a motion of the earth, and this cannot be an allusion to Eudoxus, to whose theory it is fundamental that the earth does not move. Thus we may safely say that the scheme of Timaeus contains nothing but genuine fifth-century Pythagorean ideas. There is no trace anywhere in it of the really novel astronomical ideas of Eudoxus, though it is almost certain that Plato must have known all about these ideas when he wrote the dialogue. This result is of considerable importance for its bearing on the more general question of Plato's regard for historical fact. If he is so careful not to put fourth-century astronomy in the mouth of Timaeus, we may fairly refuse to believe without evidence that doctrines, such as that of Forms and *μέθεξις*, which he represents as formulated by Socrates in early manhood were really invented by himself after the death of Socrates.[1]

39 b 3. **καὶ τὰ περὶ τὰς ὀκτὼ φορὰς πορεύοιτο**, 'and that the eight revolutions might proceed on their route'. *τὰ περὶ τὰς ὀκτὼ φορὰς* is a mere periphrasis for *αἱ ὀκτὼ φοραί* and *πορεύοιτο*, as C. W. says, is a humorous touch. The planets need a light to 'see their way'. Plato is perhaps slyly making kindly fun of his own spokesman. The Pythagoreans did mix up some very quaint anthropomorphic fancies with their science. Aristotle tells us that some of them 'accounted for' thunder by saying that the noise is meant to terrify sinners in Tartarus (*Analytica Posteriora* ii. 94^{b} 34). A.-H.'s alteration of *καὶ τὰ* to *καθ' ἅ*, which is meant to get rid of the jest, leaves *πορεύοιτο* without a subject. Almost worse is Apelt's suggestion, *πυρσεύοιτο*, which indeed appears to be no more classical Greek for 'might be lighted up' than 'might be beaconed' would be English. Chalcidius appears to have read (or misread?) *χορεύοιτο*, as he renders, 'ut . . . motuum perspicua esset chorea'. But this would require the active *χορεύοι*.

39 b 4. **φῶς ὁ θεὸς ἀνῆψεν.** Timaeus thus does not share the theory of his contemporary, Empedocles, that the sun shines by reflected light. Apparently, therefore, he does not hold the view ascribed by Aristotle to some Pythagoreans (*de Caelo* B. 293^{a} 18 ff., R. P. 83) that both the earth and sun are planets revolving round a 'central fire'. These Pythagoreans presumably thought, though I do not know whether there is *direct* evidence on the point, that the sun's light is a reflection of this central luminary. (The 'central fire' is invisible itself, because we live on the face of the earth which is turned away from it.) Aristotle does not say

[1] Thus Proclus's explanation of the words *στρέφουσα ἕλικα* seems to me thoroughly sound except that he drags in a further complication by reference to the difference between the distances of a planet from the earth at apogee and perigee. Since even Eudoxus took no account of that 'appearance', we may reasonably presume *a fortiori* that it was unknown to Timaeus and his contemporaries.

what Pythagoreans held this theory. The doxographers and other late writers ascribe it to Philolaus, a philosopher of whom Aristotle says nothing (R. P. 81, 83 a). This ascription has a grave difficulty, since, as Bt. has insisted, the astronomy of the myth of the *Phaedo*, which is geocentric and expressly states that the earth is 'at rest', is emphatically approved by Simmias (*Phd.* 109 a 8), and we learn from the same dialogue that Simmias had been a pupil of Philolaus. The 'central fire', however, appears to have figured in the work from which we get our fragments of 'Philolaus', and this would be enough to mislead the writers of doxographies. (See R. P. 81 a.) On the other hand, Empedocles notoriously explained the sun's light as a reflection, though he did not admit a motion of the earth (R. P. 170 c), and the doxographers have a curious confused statement (R. P. 83 a), according to which Philolaus held that the sun 'is glass-like, it receives the reflection of the fire in the *κόσμος*, and filters the light and heat through to us, so that in a sense there are two suns, the fiery body in the heavens (*τὸ ἐν τῷ οὐρανῷ πυρῶδες*) and the fiery reflection from it (*τὸ ἀπ' αὐτοῦ πυροειδὲς κατὰ τὸ ἐσοπτροειδὲς*)—unless, perhaps, one should add, as a third, the rays from the reflecting body which are dispersed to us by reflection'. It is difficult to make out precisely what this theory is meant to be. The 'fiery body in the heaven' *need* not be a 'central' fire; it might be a hemisphere of fire forming one half of the sky. So Empedocles taught that the 'heavens' revolve round us, one half of them being fiery and the other dark. Whether Philolaus taught much the same thing (and this is quite possible, since we know that he belonged to the Sicilian medical school, of which Empedocles was the chief figure), or really had something in some obscure way to do with the origination of the doctrines of the revolution of the earth and planets round a central fire, seems to me uncertain on the evidence. Timaeus, in any case, means that the sun is self-luminous. But what does he think about the other heavenly bodies? Since no mention is made of the kindling of any other *φῶς* than that of the sun, and it is expressly said that this was to shine *εἰς ἅπαντα τὸν οὐρανόν*, one might at first be tempted to suppose that he regards all the stars, as well as the planets, as reflections of solar light. This would not, in itself, be impossible. Empedocles had, for the first time, proclaimed the truth that the moon reflects the sun's light (*κυκλοτερὲς περὶ γαῖαν ἐλίσσεται ἀλλότριον φῶς* Fr. 45 = R. P. 170 c, *ἀθρεῖ μὲν γὰρ ἄνακτος ἐναντίον ἀγέα κύκλον* Fr. 47), and we see that he went on, on the strength of this analogy, to make the sun also a reflection of the 'fiery hemisphere'. It is always tempting to extend the latest scientific theory by analogy further than it will really stretch. It would be in keeping with this tendency if a contemporary of Empedocles tried to account for all the celestial luminaries on the analogy of the moon.[1] But on reflection we

[1] According to Aetius *Placit.* ii. 17 (*Doxogr. Graec.* 346) this view was held by Metrodorus (no doubt Metrodorus of Chios the Democritean, not the Epicurean), *Μ. ἅπαντας τοὺς ἀπλανεῖς ἀστέρας ὑπὸ τοῦ ἡλίου προσλάμπεσθαι.* Stobaeus, in his version of the passage, adds the names of Strato of Lampsacus, and Diotimus of Tyre (apparently a Democritean of the time after Alexander. See Diels *in loc.*). We may be fairly sure that we are dealing here with something which neither Metrodorus nor Strato invented; the view will rather be a part of the Ionic tradition for which they

see that Timaeus cannot mean that the 'stars' merely reflect the solar light. Their creation has not yet been mentioned. At the present stage of the story the planets are the only bodies in the 'circles', and when we come to the stars at 40 c, it is expressly said that 'fire' is their chief ingredient, and this means that they are self-luminous. But as far as the planets are concerned, the suggestion does appear to be that they are all mere reflectors of the light from the sun. I believe Timaeus does mean to extend the analogy from the moon to them. If so, he is nearer the truth than Socrates in the myth of Er, who remarks of the moon in particular, *τὸν δὲ τοῦ ὀγδόου τὸ χρῶμα ἀπὸ τοῦ ἑβδόμου ἔχειν προσλάμποντος* (*Rep.* X. 617 a 1), which seems to imply that the other planets do not get their light from the sun. (Though perhaps it is only meant that, unlike the moon, they do not shine with a 'golden light'?) There is a curious lack of information about fifth-century views on the sources of the light of the planets. Macrobius (*In Somn. Scip.* i. 19. 2) treats it as beyond question that the moon is the only body which reflects the sun's light, and makes it an argument for Plato's mistaken view about the position of the sun in the system, 'lunam non habere lumen proprium, *ceteras omnes* stellas lucere suo' (ib. 19. 9). Proclus (*in Remp.*, ed. Kroll ii. 223) seems to understand the *Republic* as teaching this, though a comparison with 224. 2–3, *τὰ μὲν γὰρ ἄλλα χρώματα φαίνεται διὰ τὸ λαμπρόν κτλ*, suggests that he perhaps means that the other planets have a feeble self-luminosity, though not enough for visibility. I take it that no one could have decided the point on evidence before Galileo's famous discovery of the phases of Venus.

39 b 6–c 1. μετάσχοι τε ἀριθμοῦ τὰ ζῷα . . . περιφορᾶς. The ζῷα in question are mankind. Number is *θεῶν εἰς ἀνθρώπους δόσις* (*Philebus* 16 c 5). The thought is that we learn to count by attending to the regular recurrence of day and night, reckoning the days which must be allowed for some operation or must elapse before its results should show, and the like, as the farmer and the sailor constantly have to do. If there were no sun, there would be no discrimination of day and night, and so no calendar, and arithmetic would never have developed. It has, in fact, been developed largely by having to keep a careful reckoning of agricultural and nautical times and seasons, like that embodied in Hesiod's Ἔργα.

39 c 2. ἡ τῆς μιᾶς . . . περίοδος. This gives us the period of a complete revolution of the *ἀπλανές*; we must remember that the distinction between the mean solar day and the sidereal day (the interval between two successive transits of the same star over the meridian), was not yet discovered. The period is therefore taken to be 24 hours, a *νυχθήμερον*.

stand, and was presumably ancient. The same language persists even to the Middle Ages. Cf. Honorius of Autun *de Solis affectibus* 21 Si a sole lumen accipiunt omnes stellae; *de origine Mundi* i. 72 omnibus stellis lumen praebens (of the sun); Dante *Paradiso* xx. 1–5 Quando colui che *tutto 'l mondo* alluma | de l'emisperio nostro si discende, | che il giorno d'ogne parte si consuma, | lo ciel, che *sol di lui* prima s' accende, | subitamente si rifà parvente; *Convivio* ii. 13 E lo cielo del sole si può comparare all' Arismetica per due proprietadi: l'una si è, che del suo lume *tutte l' altre stelle* s' informano. Even Milton says (*P. L.* vii. 364) 'Hither as to their Fountain other starrs | Repairing, in their gold'n Urns draw Light, | And hence the Morning Planet guilds his horns', where the antithesis between the stars and the planet seems to indicate that 'other starrs' does not simply mean the planets.

νύξ is mentioned before ἡμέρα in accordance with the practice of reckoning the day from sunset to sunset, which now survives only in ecclesiastical ritual, (a festival beginning with Vespers). The month and year: the month is said to run from one conjunction of moon and sun to the next, and at the same time to be the period of one revolution of the moon in its orbit. Timaeus thus does not distinguish the true *sidereal* month of 27 days, 7 hours, and 43 minutes—the period of the moon's revolution—from the *lunar* month or synodic period—the interval from new moon to new moon—of 29 days, 12 hours, 44 minutes. The latter is longer than the former, because, to put it from the point of view of the terrestrial spectator, the sun has gone nearly $\frac{1}{13}$ of his annual journey, while the moon completes her revolution, and she has to 'catch him up' in order to come into conjunction with him. As no figures are given, we may perhaps fairly suppose that Timaeus is not distinguishing either of these 'months' from the conventional 'calendar month'. Probably he is thinking of the traditional calendar month of 30 and calendar year of 360 days. Plato's own proposed civil year in the *Laws* was to be one of 365 days (*Laws* 828 a–b) with twelve months. It is thus a conventional solar year. But, as C. Ritter observes in his commentary on the passage, such a length for the civil year is in sharp opposition to all known Greek calendars of the earlier time, and it is not Plato but Timaeus who is speaking here. Note the assumption, due to the theory of the double motion, that the moon is 'swifter' than the sun; it is she who 'catches' the sun.

39 c 5—d 2. τῶν δ' ἄλλων . . . θαυμαστῶς. The complaint is that men are content to ascertain only the periods of the sun and moon, and to compare them with one another. The constructors or reformers of calendars (like Meton) concern themselves solely with establishing a relation between the year and the month. They are not—with the exception of a few Pythagoreans—aware of the periods of the other five circles. They give these periods no names (*οὔτε ὀνομάζουσι*), though they have names (*μείς* or *μήν* and *ἐνιαυτός*), for the lunar and solar periods, and do not try to compare the 'year' of one planet with that of another. As for the Pythagorean reckoning, we have already seen that Venus and Mercury are supposed to have the same period of revolution as the sun. That of Mars was taken as 2 years, that of Jupiter as 12, that of Saturn as 30. (The real figures are: Mars, 1 year, 321 days, 2 hours; Jupiter, about 11 years, 343·5 days; Saturn, 29 years, 167 days.)[1]

39 d 1. οὐκ ἴσασιν χρόνον ὄντα. This is because they think of the path of a planet as a mere *πλάνη*, an irregular 'stroll' or 'ramble'. Hence they do not understand that it is really 'time', i.e. that you could measure the passage of events just as well by the regular revolutions of any other body as by those of the sun or moon. The period of Mars is

[1] For the computation of the period which was generally adopted cf. [Arist.] *de Mundo* 399ᵃ 8 *ἥλιος δὲ ἐν ἐνιαυτῷ καὶ οἱ τούτου ἰσόδρομοι, ὅ τε Φωσφόρος καὶ ὁ Ἑρμῆς λεγόμενος, ὁ δὲ Πυρόεις ἐν δἰπλασίονι τούτων χρόνῳ, ὁ δὲ Διὸς ἐν ἑξαπλασίονι τούτου* (i.e. in 6 × 2 years, not in 6 years as the Oxford translation renders), *καὶ τελευταῖος ὁ τοῦ Κρόνου λεγόμενος ἐν δἰπλασίονι καὶ ἡμίσει τοῦ ὑποκάτω* (sc. in $12 \times \frac{5}{2} = 30$ years). *Placita* II. 32, 1 (*Doxographi* 363).

just as much a 'natural unit' for estimating duration as what we call a month or a year.

39 d 1–2. πλήθει . . . θαυμαστῶς. The πλῆθος, one may suppose, refers to the very high numbers which would occur as antecedents and consequents of the ratios if we set ourselves to an exact determination of the periods of all the planets in terms of the period of each, as well as to the number of such equations which we should have on our hands. The πεποικιλμένας, as Proclus says, refers to the great variety and intricacy of the motions relatively to one another, and the number of different cyclical rhythms which we may detect in the system (διὰ τὰς χορείας αὐτῶν καὶ τὰς παραβολὰς καὶ τὴν ἐναρμόνιον κίνησιν καὶ τὴν τάξιν τῶν ἀποκαταστάσεων).

39 d 2–7. ἔστιν δ' ὅμως . . . κύκλῳ. Since, as we have been told before (36 d 6), the periods of the various circles have each a λόγος or ratio to every other (i. e. the fraction $\frac{\text{period of } x}{\text{period of } y}$ is always a rational fraction), there must be a very long period after which *all* the heavenly bodies have once more the precise relative positions as they had at its beginning, i. e. all the planets once more come back simultaneously to a former position in the Zodiac. From sufficient knowledge of the periods of the eight circles you can discover the length of this great cycle, which is called a τέλεος ἐνιαυτός 'perfect year' because it is one complete period of the whole assemblage of circles 'just as what we commonly call the ἐνιαυτός is one complete revolution of the circle of the sun. It is the time needed for *all* the wheels to 'come full circle' together. Timaeus does not say what the duration of this *magnus annus* is. He merely says that it is a whole number of days (τῷ τοῦ ταὐτοῦ καὶ ὁμοίως ἰόντος ἀναμετρηθέντα κύκλῳ). Granting that there *is* a diurnal revolution of the ἀπλανές, and that all the other slower revolutions have to it the 'ratio of an integer to an integer', this much is obvious. When the cycle begins, the ἀπλανές is just beginning a revolution, and when it closes the ἀπλανές has just completed a revolution. The 'complete' or 'perfect' number, then, is the number of days of twenty-four hours comprised in this cycle. It is called a τέλεος ἀριθμός simply because it measures a τέλεος ἐνιαυτός. We must not introduce any of the associations connected with the arithmetical use of τέλεος as an epithet for certain integers. (The δεκάς was called τέλεος ἀριθμός for various reasons which are set forth at length by Speusippus (Fr. 4), and the name is also given by Euclid *Elements* vii. Def. 23, and the later writers on arithmetic to numbers like 6, which are 'equal to the sum of their divisors', but these meanings are excluded here by the simple consideration that the number in question is not specified.) Timaeus need not be supposed to have any theory about the actual number of days in the period. He does not profess that he knows the length of the 'complete year', but only that it is possible to determine it (δυνατὸν κατανοῆσαι). There appears to have been no definite tradition in the fifth century about the length of the *magnus annus*. Some fixed it at 8 years, others at 19, others at 59. (*Placita* ii. 32. 2, τὸν δὲ μέγαν ἐνιαυτὸν οἱ μὲν ἐν τῇ ὀκταετηρίδι τίθενται, οἱ δὲ ἐν τῇ ἐννεακαιδεκαετηρίδι, οἱ δὲ ἐν τοῖς ἑξήκοντα ἐνὸς δέουσιν.) The determination of the 59-year period was that of Oenopides of Chios (Theo Smyrnaeus 198. 14, who

reports, apparently from Dercylides, ὅτι Οἰνοπίδης εὗρε πρῶτος . . . τὴν τοῦ μεγάλου ἐνιαυτοῦ περίστασιν, Aelian *V. H.* x. 7. See *Fr. d. Vors.*[3] i. 297.)[1] The 19-year period is that ascribed to Meton in the Periclean age. The 8-year period was ascribed to the famous early astronomer Cleostratus of Tenedos (*c.* 520 B.C., see *Fr. d. Vors.*[3] ii. 198), whose pupil Meton is said by Theophrastus to have been. The object of the authors of these periods, however, was simply the practical rectification of the calendar by devising an appropriate way of keeping the lunar and solar years together. None of the three cycles is a solution of the problem suggested by Timaeus of keeping the 'years' of all the circles together, and it is thus not probable that he has any of them in mind. He is suggesting a problem, not indicating its solution. There is no suggestion that the end of the period is marked by any cosmic cataclysm, or that the events of the cycle are repeated in the next cycle, any more than the end of a year is marked by violent natural upheavals or that the events of one year are a mere repetition of those of the year before. We have no right to read the apocalyptic ideas of the Orphics or the ἐκπύρωσις of the Stoics into the mere statement of an arithmetical problem. Still less have we any right to credit Plato himself with these ideas.

It has been customary to connect what is said here about the τέλεος ἐνιαυτός with the famous passage in the *Republic* (viii. 546) about the periods of a θεῖον γεννητόν and an ἀνθρώπειον γεννητόν. For a full discussion of the difficulties of that passage, and a solution of them which seems to me sound in its main outlines, I must be content to refer to the exhaustive excursus on the subject appended to Bk. viii of the *Republic* in Adam's commentary. Here I need say little more than that I agree wholly with Adam that the *Republic* does not attempt to specify the period of the θεῖον γεννητόν at all. Personally I believe that he is right in holding that the mysterious number described in the closing words of the passage as an ἀριθμὸς γεωμετρικός is (3600^2), the number of days in a cycle of 36,000 years of 360 days each, and that it is got out of the number 216 (that of the ἀνθρώπειον γεννητόν, 'the seven-months' child'), by a series of operations such as he has described. But I see no reason to identify this period of 36,000 years with that of the ἀποκατάστασις of the heavenly bodies to which Timaeus refers. There is great force in the contention of Proclus that a number which, in the words of the *Republic*, is κύριος ἀμεινόνων καὶ χειρόνων γενέσεων for the Universe could only be computed if we knew the periods of *all* the rhythmical processes in the Universe, from the duration of a 'generation' of ephemera upwards, and cannot be identified with a cycle computed solely from the periods of the

[1] Aelian ascribes the 59-year period to 'Oenopides and Pythagoras'. As Eudemus expressly regarded the determination as the work of Meton, this means no more than that Oenopides (a younger contemporary of Anaxagoras) was connected with the Pythagorean order. This is shown also by the assertion (*Placita* ii. 12. 2, *Doxographi* 340) that Oenopides tried to pass off as his own the discovery of the obliquity of the ecliptic, which really belonged to Pythagoras. (As a matter of fact the credit really belongs to Anaximander.) On the *Octaeteris* and the other attempts to keep sun and moon together see Heath, *Aristarchus of Samos* c. xiv. (pp. 284–97). The 19 years' period is an approximate statement of the length of the well-known 'ecliptic cycle' (Pliny *N. H.* ii. 13).

celestial circles.[1] It is not even fully made out to my mind that the 36,000 years of the *Republic*, if that is really the period described, is meant to be that of a τέλεος ἐνιαυτός in the purely planetary sense in which Timaeus is employing the phrase. There is no sufficient evidence, so far as I know, that Plato attaches any *astronomical* significance to this period. Adam seems to me to suggest an entirely adequate explanation of the significance of the period which is wholly unastronomical, when he remarks that 36,000 = 360 × 100, and that in the myth of Er 100 years is taken as the limit of human life. The thought will thus be that a human life is a day in the year of the κόσμος (Adam *Republic of Plato* ii. 301). For an astronomical significance of the number he only produces (*op. cit.* ii. 304) late medieval evidence that the period was called *annus Platonicus*. That Plato regarded it, or that it was regarded by any of his precursors, as the period of ἀποκατάστασις of the planets seems to be wholly unproved. Proclus knew of no such tradition, since it is never mentioned by him in discussing either the *Republic* or the *Timaeus*. And others gave a wholly different computation. Chalcidius, who rightly denies that the end of the period is marked by any cataclysm,[2] merely remarks that the computation is beyond us.[3] Dercylides, as we have seen, quotes Eudemus as ascribing the discovery of the 'great year' to Oenopides, and this suggests that Dercylides supposed the 59-year period to be what Timaeus means by the τέλεος ἐνιαυτός. In Cicero's *Somnium Scipionis* (vii. 4) it is said that the time which has elapsed from the death of Romulus to the date of Scipio's vision, some two years before the destruction of Carthage, is something under one-twentieth part of the *magnus annus*. This is explained by the comment of Macrobius that Cicero estimates the 'great year' at 15,000 solar years, and that the interval from the death of Romulus to the dream is only 573 years.[4] Clearly Cicero knew of no tradition that Plato's great astronomical period was 36,000 years. If the tradition were really of any authority it is strange that neither Cicero nor Dercylides should know this, and that Proclus has plainly never heard anything about it. An earlier medieval tradition than that mentioned by Adam is preserved by Honorius of Autun (*de Origine Mundi* ii. 70), who gives the period as 9,000 years. Possibly the origin of the late statements upon which Adam relied is simply that, as is well known, Hipparchus, the discoverer of 'precession',

[1] Proclus (ed. Diehl) iii. 93 πλὴν προσκείσθω τοῖς εἰρημένοις ὅτι τοῦτον τὸν τέλειον ἀριθμὸν ἐκείνου τοῦ ἐν Πολιτείᾳ ῥηθέντος, ὃς τὴν παντὸς τοῦ θείου γενητοῦ περιλαμβάνει περίοδον, οἰητέον διαφέρειν, μερικώτερον ὄντα καὶ μόνον τῶν ὀκτὼ περιόδων ἀποκαταστατικόν· ἐκεῖνος γὰρ καὶ τῶν ἐν τοῖς ἀπλανέσι κινήσεων (*sc.* the axial rotations which Timaeus ascribes to the stars) ἰδίων καὶ τῶν ἐν πᾶσιν ἁπλῶς τοῖς ἐν οὐρανῷ κινουμένοις . . . καὶ τῶν ἐν τοῖς ὑπὸ σελήνην μακροποροτέρων ἢ βραχυποροτέρων περιόδων φορῶν τε καὶ ἀφορισῶν ἐστι περιληπτικός.

[2] *Comment.* 118, p. 184 Wrobel, quem quidem motum et quam designationem non est putandum labem dissolutionemque adferre mundo. (Obviously this is a stricture on Stoics, who had professed to find their ἐκπύρωσις in the dialogue, and one may reasonably suspect that it comes in the end from Panaetius, who is known to have expounded the *Timaeus* and notoriously differed from most of his sect by disbelieving in the ἐκπύρωσις.)

[3] *ib.* Wrobel p. 183 Hoc autem tempus continet annorum innumerabilem seriem.

[4] Macrobius *in Somn. Scip.* ii. 11 mundanum annum quindecim milia annorum quales nunc computamus efficiunt ff.

estimated the precessional period at 36,000 years (making the amount of precession 1° in a century), and that Ptolemy adopted his estimate. This period might then easily come to be supposed to be that of which Timaeus is speaking. That Plato himself knew nothing about precession seems to me to be clear from a simple consideration advanced by Proclus. If Plato had wanted to talk of precession he would have had to describe it by saying that the stars move in the same direction as the planets.[1] That is, Plato would have had to give the ἀπλανές a double movement, a diurnal one contrary to the planets and a second very slow one in the same direction with them. But in point of fact Plato only speaks of *one* movement of the ἀπλανές, that in the counter sense to the planets.[2] This reasoning seems to me quite unanswerable.

39 d 5–6. σχῇ κεφαλήν. There is no doubt about the general sense, which is that at the end of the *magnus annus* all the planets return to their original positions relative to one another. This seems to have been understood by later ages to mean in particular that they are then all 'in conjunction' (i. e. in one sign of the Zodiac). But it was not so clear whether this meant only that they must all be in *one* sign or that they must all be in the *same* sign as at the beginning of the 'great year'. Of course, if the latter is meant, the cycle will have to be longer. One may doubt whether it can be determined whether Timaeus means precisely that the planets must all be 'in conjunction', but whatever the positions are, he clearly means that the identical arrangement which marked the opening of the period also recurs at its close. The phrase κεφαλὴν ἔχειν is clearly, as A.-H. says, a technicality, but it is not known what it meant in the fifth century or exactly what metaphor is at the bottom of it. Cicero translates by 'se ad idem caput retulerunt', which suggests that

[1] We say that the equinoctial *points* retrograde, but Plato would have had to say that the *constellations* have a *forward* motion. (This is because the expression 'the first point of Aries' has become to us a conventional expression for the point where the sun is at the Equinox, so that we can say that the 'first point of Aries' has shifted back into the *constellation* Pisces. To be understood at all Plato would have had to express the same thing by saying that the *constellation* Aries tends to advance.) The point is rightly made by Boeckh, without any reference to Proclus, in *Kosmisch. Syst. des Platon*, pp. 33, 34.

[2] Proclus *in Remp.* (ed. Kroll) ii. 235 τὸ δὲ καὶ τὴν ἀπλανῆ κινεῖν ἐπὶ τὰ ἑπόμενα καὶ μοῖραν μίαν ἐν ἔτεσιν ἀπλέτοις, οὐδὲ τοῦτο δήπου τῷ Πλάτωνι προσῆκεν, σαφῶς λέγοντι τὰς ἐναντίας εἶναι κινήσεις ἐν τῇ ἀπλανεῖ καὶ τῇ πλανωμένῃ. Cf. the long polemic against Hipparchus and Ptolemy, Procl. *in Timaeum* (Diehl) iii. 124 ff. Proclus also holds that over and above the motions of the 'circle of the Other', the planets have also a rotation on their axes, and that our inability to determine the period of these rotations is one reason why we must not expect to be able to specify the great secular period spoken of in the *Republic*. He returns over and over again to this point (*in Timaeum* [Diehl] iii. 55, 67, 96, 128; *in Remp.* [Kroll] ii. 223. He is, as we know, right about the fact, but he does not convince me that *Timaeus* intends anything of the kind. At bottom Proclus' point is that every planet has a ψυχή *of its own*, and therefore must have a motion initiated by that ψυχή over and above the motions due to the presence of the cosmic soul in the various circles. I cannot, however, find that *Timaeus* says anything about these planetary ψυχαί, and I therefore think it unjustifiable to argue from what he does say about the *stars*. All he says about the planets is that they are δεσμοῖς ἔμψύχοις δεθέντα, and this suggests, if anything, that he does *not* ascribe separate ψυχαί to them. It should, however, be mentioned that Sir T. L. Heath accepts the view of Proclus, though without adding anything to his arguments for it. (*Aristarchus of Samos* p. 174.)

he took κεφαλή to mean 'starting-point'. Chalcidius paraphrases, 'velut ad originem atque exordium circumactionis alterius revertentur'. Proclus (Diehl iii. 92) hurries over the phrase with the remark, ἔχοντα κεφαλὴν τὴν ταὐτοῦ φοράν· ὡς γὰρ ἐπ' ἀρχὴν ἐκείνην ἀνάγεται, a remark which looks like that of a commentator who is puzzled by the word. There is an obviously closely connected expression in Aetius ii. 32. 2 (*Doxogr. Graec.* 364), where it is said that 'some' place the μέγας ἐνιαυτὸς ἐν τῇ λεγομένῃ κεφαλῇ τοῦ χρόνου (MSS. Κρόνου, which should be corrected), αὕτη δ' ἐστὶ τῶν ἑπτὰ πλανητῶν ἐπὶ ταὐτῇ ἡμέρᾳ τῆς ἐξ ἀρχῆς (MSS. ἄρκτου, which seems unintelligible) φορᾶς ἐπάνοδος. Unfortunately, this is pretty clearly a mere reference to our own passage, and so throws no light on the way in which κεφαλή comes to be used in such a sense.[1] Perhaps the nearest known sense of κεφαλή to that which we want here is 'crown', 'completion', as in the phrase κεφαλὴν ἐπιθεῖναι τῷ μύθῳ (*Tim.* 69 a), 'to put the finishing touch to the fable'. The other parallels given in L. & S., s. v. κεφαλή iv. 2, are all from Plato himself. The metaphor looks as though it were architectural, to 'put the capital' on a column. The use of κεφαλή or κεφάλαιον in the sense of *summa* 'sum total' has the same origin as in accounts it was customary to write the sum total *above* the items. Cf. our 'column' of figures.

39 d 8. ὅσα . . . ἔσχεν τροπάς. A periphrasis for πλανητά. τροπαί means 'turnings back'. It is important for the understanding of early astronomy not to confuse the senses of τρέπεσθαι and στρέφεσθαι. τρέπεσθαι is to go back on one's steps, to reverse one's course, στρέφεσθαι to turn round, to rotate. The τροπαί of the sun are his turning back southward at midsummer after touching the 'tropic' of Cancer, and northward in winter after touching the 'tropic' of Capricorn. The planets have still more complicated τροπαί. They stray in latitude from the sun to the N. and S., and come back again; and further, since they alternately retrograde and advance, they have τροπαί to the E. and W. The stars have no τροπαί. They apparently wheel steadily round in circles, and Timaeus also holds that each star has an axial rotation. Both these movements can be called στροφαί. But we do not see them 'turn back' on their steps.

[1] The *phrase* recurs [Plut.] *de Fato* 569 a, but this is a mere quotation from Timaeus's words. In the passage of the *Placita* Diels in *Fr. d. Vorsokr.*[3] i. 297 now reads κόσμου for the Κρόνου of the MSS., but it is pretty clear that the true text is χρόνου. Cf. Joannes Lydus *de Mensibus* iii. 4 διὰ τοῦτο τὴν κεφαλὴν τοῦ χρόνου οἱ Πυθαγόρειοι οὐχὶ πρώτην ἀλλὰ μίαν ὠνόμασαν, and S. Basil *Homil. in Hexaemeron* ii. 8 (Migne p. 50 c) διὰ τοῦτο τὴν κεφαλὴν τοῦ χρόνου οὐχὶ πρώτην ἡμέραν ἀλλὰ μίαν ὠνόμασεν, where the reference is to *Genesis* i. 5 καὶ ἐγένετο ἑσπέρα καὶ ἐγένετο πρωί, ἡμέρα μία. It thus appears that there was a tradition that the Pythagoreans used the expression κεφαλὴ χρόνου, 'the head' of time, for the beginning of a complete planetary cycle. It will be this Pythagorean phrase which Timaeus is echoing. (I owe the two valuable references to Joannes Lydus and Basil to my friend Mr. Lorimer.) For this use of κεφαλή to mean the *beginning* of something cf. Joannes Lydus iii. 12 ἡ νεομηνία κεφαλὴ μηνὸς πρὸς τῶν ἀρχαίων προσαγορεύεται; iii. 22, the Babylonians and Egyptians ἀρχὴν ἐνιαυτοῦ τὴν ἐαρινὴν ὡρίσαντο τροπήν, ὥσπερ ἀπὸ κεφαλῆς τὴν ἐν Κριῷ ἰσημερίαν λαμβάνοντες; Philo, *Quaestiones in Exodum* i. 1 Nam caput Zodiaci vocant arietem in quo visus sol generat vernale aequinoctium. (And compare the use of *caput* in Latin for a spring or well-head of water, and the familiar Italian *da capo*. The old belief, found for example in Dante, that the sun was created in the first point of Aries, belongs to the same set of ideas.)

39 d 8—e 2. **ἵνα τόδε . . . φύσεως.** The visible οὐρανός has its life in time, not in eternity, but the way in which its life is made up of unending cycles of motion is the nearest approach which 'passage' (τὸ γιγνόμενον) can make to the abiding self-sameness and quiet of eternity. It is this recurrence of the same great cosmical rhythm (the unit of the rhythm, the 'bar' of the music, so to say, being the τέλεος ἐνιαυτός), that Timaeus had in his mind when he called time a 'moving image of eternity'. For some more general observations on the concept of Time, see Appendix IV.[1]

39 e 3—41 a 6. *The creation of living beings other than the* **οὐρανός** *and the planets.* The Creator now proceeds to supply the οὐρανὸς with as many kinds as there are types or patterns (ἰδέαι) in its archetype. Timaeus, following still the rough and ready enumeration of the Empedoclean 'four roots', holds that there are four great types of living beings, who live respectively in the sky (thought of as the home of light, the finest kind of fire), in the air, in the water, on the dry land. The 'divine' living beings whose abode is in the sky are, as we see at 40 a, the stars. They are not the planets, whose making has been described already, but the true stars, so that we get the curious result that the planets are supposed to be made before the stars. The order is due to a consideration which has probably no physical significance. The planets had to be brought into the exposition early in order to explain the nature of time, since it is by their revolutions in the circle of the Other that we learn to distinguish years, months, and seasons. The stars are not indispensable for this purpose. If there were none of them and the circle of the Same were empty, we could still recognize the difference of day and night, as the sun would be regularly brought round to his rising and setting by the motion of the Same. Only, of course, though we could tell that the longest day is a good deal longer than the shortest, we should not be able to make our estimate of the νυχθήμερον very accurate. We should, in fact, find it much harder than we do to distinguish between the actual solar day and the 'mean' solar day, and, of course, should know nothing about the 'sidereal day' at all. But Timaeus is not aware of these differences. Hence, from his point of view, the stars play no part in the determination of time, though the risings and settings of some of them are important to the farmer and the sailor.

39 e 4. **τὸ δὲ μήπω . . . ἀνομοίως.** The consensus of A and F should turn the scale against the facile alteration τῷ δέ. The words τὸ δὲ . . . περιειληφέναι are an 'adverbial accusative'. 'But in respect that it did not yet contain, . . . so far (ταύτῃ) it was still unlike its model.' The same account holds of the following τοῦτο, which must not be taken with τὸ κατάλοιπον, '*wherefore*, to be sure, he completed what still remained to be done'. With the use of ταύτῃ answering to the preceding τό, cf. *infra* 91 b 2, λαβὼν ἀναπνοὴν τοῦθ' ἥπερ ἀνέπνευσεν, with my note *ad loc.*; Aristophanes *Thesmophoriaz.* 546, ἐπίτηδες εὑρίσκων λόγους ὅπου γυνὴ πονηρὰ | ἐγένετο.

[1] On the whole subject of 'Plato's' theory of time see the able essay of A. Levi, *Il Concetto del Tempo nei suoi Rapporti coi Problemi del Divenire e dell' Essere nella Filosofia di Platone.* (Turin, undated, but published in 1920 or 1921.)

39 e 7–9. ἥπερ οὖν . . . σχεῖν. A formal identification of the Creator with νοῦς, and of his model with τὰ νοητά. Since the Creator reproduces the types which νοῦς contemplates in the ὃ ἔστι ζῷον, the sentence, of course, means exactly what it would have meant if Timaeus had said that he copied the types he himself 'beheld'. Note that the usage of ὃ ἔστι as a sort of indeclinable prefix in speaking of the Forms is here assumed to be habitual with the Pythagoreans. So in the *Phaedo* (92 d 9) the phrase ἡ οὐσία ἔχουσα τὴν ἐπωνυμίαν τὴν τοῦ ὃ ἔστιν is assumed to be understood without explanation by Simmias, and at 75 d 1 Socrates speaks of 'all the things on which we set the seal of the αὐτὸ ὃ ἔστι' (οἷς ἐπισφραγιζόμεθα τὸ αὐτὸ ὃ ἔστι). Thus Plato plainly intends to assert that this technical language, and consequently the whole doctrine of Forms, from which it is derived, belongs to the fifth century. If we had only the *Phaedo* to go on, we might suppose that the phrase αὐτὸ ὃ ἔστι was peculiar to Socrates and his circle, but when we find Timaeus talking exactly in the same way, we are forced to suppose that the suggestion is that the language was Pythagorean.

In *Epinomis* 984 b 2—986 a 3 we have the denizens of the οὐρανός classified under *five* heads by the introduction of αἰθήρ, the region between the stars and our atmosphere, as an abode for δαίμονες, superhuman beings inferior to θεοί, and this became the standing Academic doctrine. This is, however, only a minor detail, its chief advantage being that it makes the number of regions correspond with that of the regular solids. We shall meet again with the discrepancy between the numbers in our dialogue. It is a sign that the two sources of Timaeus's doctrine, Pythagorean mathematics and Empedoclean physics and biology, will not really fuse completely. Timaeus is, after all, an 'eclectic', and cannot quite escape the standing danger of all eclecticism.

40 a 2. τοῦ μὲν οὖν θείου. The stars are *mostly* made of fire (τὴν πλείστην ἰδέαν), though the other roots also are assumed to be present in them. Just as *we* belong to the πεζὸν καὶ χερσαῖον εἶδος, and earth plays the prominent part in our constitution, but, as we shall see, there is 'fire' in the eye, and *all* the roots enter into our structure.[1] That 'the stars are fire', and, speaking generally, that heavenly bodies and bodies terrestrial are made of the same stuff was the standing assumption of Greek cosmology down to Aristotle. Until that philosopher invented the absolute distinction between 'elementary matter' (matter in the form of the Empedoclean roots) and the 'fifth body', no one had ever supposed that the 'heavens' and their contents are made of anything but the stuff of which everything else is made, and consequently no one had credited the 'heavens' with a dynamic of their own. The tacit presupposition of the two leading analogies of the old cosmologies, the analogy from 'eddies' and that from stones swung round in a sling, is that the

[1] If Augustine accurately represents the doctrine of the *Platonici* in his own time (beginning of the fifth century A.D.), they had strayed from the teaching of Timaeus. According to him (*de civit. Dei* xxii. 11) they had inferred from what is said at 32 b–c about the use of water and air as μεσότητες between earth and fire that 'non potest esse terrenum corpus in caelo', and Augustine accordingly sets himself to defend the 'resurrection of the body' against this objection.

'heavens' obey the same dynamical laws as everything else. Aristotle's reasons for his innovation were (1) that he held on *a priori* grounds that the revolutions of the 'spheres' are all absolutely uniform and continuous, and therefore must be circular, as the circle is the only (plane) curve of constant curvature, and the only path which can be followed continuously and endlessly. (Rectilinear motion could go on continuously and endlessly in an infinite void, but Aristotle holds that there is no actual ἄπειρον and no 'void' outside the Universe. If anything in the Universe had a rectilinear motion which went on endlessly, it would have to reverse the sense of its movement periodically, and the reversal would be a breach of continuity. Thus the rectilinear movements of the 'elements' cannot be uniform, continuous, and endless.) (2) Also 'elementary' or 'terrestrial' bodies cannot be the subjects of the endless circular revolution, since (*a*) every compound can be dissolved into the 'roots', and the 'roots' in turn are capable of continuous transmutation into one another, but no changes ever occur in the heavenly bodies except the change of their relative positions, and (*b*) experience shows that 'elementary body', left to itself, always follows a rectilinear path, whereas, for reasons just given, the path of a heavenly body must be circular. Since the dynamics of the heavens are thus totally different from terrestrial dynamics, the body which follows such wholly different laws must be different too. The *locus classicus* for this argument in Aristotle's works is *Physics* Θ. cc. 9, 10 (265^a 13—267^b 26). What a clear-sighted Academic thought of it we may see from the criticism of the Platonist, Atticus, preserved by Eusebius.[1] 'As for the so-called elements, which are the rudimentary constituents of bodies, Plato, following the plain evidence of facts, said, like his precursors, that there are four of them, fire and earth and air and water, and that all other things are produced by combinations of them. But Aristotle, imagining it should seem that he would appear highly original if he added an extra body, threw in besides the four bodies we all perceive his 'fifth substance'. This was to treat nature with a magnificent generosity, but not to understand that the physicists' business is to discover the facts of nature, not to prescribe laws to her. . . . Our teaching is that *every* body is either hot or cold, moist or dry, soft or hard, light or heavy, rare or dense, and we find that a thing which is to exhibit these characters can be nothing but one of the four. If it is hot, it will be fire or air; if cold, water or earth; if dry, fire or earth; if moist, water or air; if soft, air or fire; if hard, water or earth; if light, it will be rare, like fire and air; if heavy, it will be dense, like earth and

[1] Eusebius *Praep. Evang.* xv. 7 περὶ γοῦν τῶν καλουμένων στοιχείων, ἐξ ὧν πρώτων σώματα συνέστηκε, Πλάτων μὲν ἑπόμενος τῇ περὶ αὐτὰ ἐναργείᾳ, καθάπερ καὶ οἱ πρὸ αὐτοῦ, τέσσαρά τε ἔφησεν εἶναι ταῦτα ὁμολογούμενα (? τὰ ὁμ.), πῦρ καὶ γῆν καὶ ἀέρα καὶ ὕδωρ, καὶ ἐκ τούτων συγκρινομένων τὰ λοιπὰ πάντα γεννᾶσθαι· Ἀριστοτέλης δέ, ὡς ἔοικεν, ἐλπίσας περιττότερος φανεῖσθαι τῷ φρονεῖν εἴ τι σῶμα ἐκ περίττου προσθείη, προσκατηρίθμησε τοῖς φαινομένοις τέτταρσι τὴν πέμπτην οὐσίαν, πάνυ μὲν λαμπρῶς καὶ φιλοδώρως τῇ φύσει χρησάμενος, μὴ συνιδὼν δὲ ὅτι οὐ νομοθετεῖν δεῖ φυσιολογοῦντα, τὰ δὲ τῆς φύσεως αὐτῆς ἐξιστορεῖν. . . . μόνον οὐχὶ λέγων σῶμα οὐ σῶμα. τὸ μὲν γὰρ ὄνομα καταλέλοιπεν αὐτῷ, τὰς δὲ δυνάμεις, δι' ὧν σῶμα πέφυκε γίνεσθαι, πάσας ἀφῄρηκεν. Atticus thus complains in effect that the 'fifth body' introduces a 'bifurcation' into Nature.

water. So by consideration of all the simple qualities we discover that there can be no bodies except these four. Aristotle *alone* stands in opposition, declaring that there can be a body without any of these qualities, a body which is neither heavy nor light, soft nor hard, not moist and yet not dry; this is, in effect, to say a body which is not a body. He has left it the name but removed all the qualities which make a body a body. Since[1] there are four bodies, and all of them naturally have a simple rectilinear motion, Plato . . . assigned circular motion to the *soul*,[2] but Aristotle assigns circular motion to his fifth body, and so falls into a very simple delusion. For it was [i. e. it was by Aristotle's account] the weight or lightness of bodies which move in a straight line which provided a source for their movements,[3] but since the fifth body has neither weight nor lightness, it ought to be a source of rest rather than motion.'

From the words ἐκ πυρός we may reasonably infer that Timaeus did not mean to say at 39 b 4 that the stars are not self-luminous, for πῦρ, we have been told, is naturally ὁρατόν. But he clearly regards what light or heat they emit as of no great consequence in the scheme of things.

40 a 4. εὔκυκλον. I. e. the stars are spherical bodies.

40 a 4–7. τίθησιν—καθ' ὅλον. Since we have been told that body is really *in* soul rather than soul in body, this is just a way of saying that the stars are subjected to the κράτος of the circle of the same and carried round by the diurnal revolution. They are not, of course, strictly *in* that circle itself, for they are not all in the plane of the Equator, but occupy all sorts of positions between the Equator and the Poles (νείμας περὶ πάντα κύκλῳ τὸν οὐρανόν. But they all share in the diurnal movement from E. to W. This is what ἐκείνῳ (sc. τῷ κρατίστῳ) συνεπόμενον means. It is called τὸ κράτιστον with special reference to what was said of the κράτος given to it.

κόσμον ἀληθινόν is a play on two meanings of the word κόσμος. One of these senses is 'adornment'. Part of the meaning is that the stars help to make the οὐρανός a 'thing of beauty'. As for the other senses Proclus seems to be right in supposing that it is not 'Universe' in general but the 'outermost heaven', the ἔσχατος Ὄλυμπος of the Pythagoreans. It is this which the presence of the stars makes πεποι-

[1] Eusebius *Praep. Evang.* xv. 8 ὁ μὲν γὰρ Πλάτων, ἅτε ὄντων τεττάρων σωμάτων καὶ πάντων φύσει κινουμένων ἁπλῆν καὶ εὐθεῖαν κίνησιν, . . . τὴν ἐν κύκλῳ κίνησιν ἀπέδωκε τῇ ψυχῇ· ὁ δ' ἤπερ ἄλλῳ σώματι ἄλλην, οὕτω δὲ καὶ τὴν ἐν κύκλῳ, καθάπερ σωματικήν τινα, τῷ πέμπτῳ προσένειμε σώματι, πάντ' εὐκόλως αὐτὸν ἐξαπατήσας κτλ.

[2] i. e. Plato ascribes the circular movement both in the *Timaeus* and in the *Laws* to the purposive control of bodies by intelligent νοῦς; Aristotle treats it as mechanically ultimate and calling for no explanation. As we should put it, Plato, like Newton, holds that what we call 'gravitation' requires a 'cause' or 'explanation', though, again like Newton, 'hypotheses non fingit'. He is content to hold that in some way unknown to us it is 'best it should be so'; Aristotle thinks no explanation necessary. (Burnet, *Greek Philosophy, Thales to Plato* p. 335 *n.*)

[3] i.e. Aristotle says the reason why earth, left to itself, moves *down*, is that it is heavy; the reason why fire moves *up* is that it is *light*. Since, then, he also says that the 'heavens' are neither light nor heavy, we should expect him to say that they do not move at all.

κιλμένον καθ' ὅλον.[1] The ἀληθινόν may thus be compared with the phrase of the *Epinomis* 987 b 7 ὃν μάλιστά τις ἂν κόσμον προσαγορεύοι. For πεποικιλμένον cf. the 'spangled firmament' of the well-known hymn, or even better Mr. Yeats's line about the 'heaven's *embroidered* cloths', since ποικίλλειν is so frequently used of 'broidering' a robe or tapestry. So Aeschylus (*P. V.* 24) speaks of ἡ ποικιλείμων νύξ, 'night with her broidered skirts'.

40 a 7–b 2. κινήσεις δὲ δύο . . . κρατουμένῳ. Each star has two motions, an axial rotation (τὴν μὲν ἐν ταὐτῷ) and the 'diurnal' circular revolution communicated to it by the circle of the Same (τὴν δὲ εἰς τὸ πρόσθεν, i.e. the movement ἐπὶ δεξιά already described). We understand at once what are the appearances for which this second motion accounts, the periodical transits of the stars across the meridian, the risings and settings of the constellations. But for what appearances does the axial rotation account? Note that Timaeus is not speaking of the *planets*. *We* know that the planets have axial rotations and that the 'day', e.g. of Mars lasts approximately 24 hrs. 37·25 min., that of Saturn 10·25 hrs. But Timaeus had no means of knowing these facts; still less were there any appearances to suggest a rotation of a 'fixed' star. Hence his reasons for asserting that the stars have such rotations must be *a priori*. No doubt the point is that a star is a being with a ψυχή, and a ψυχή is an ἀρχὴ κινήσεως. Therefore the star must have a proper κίνησις of its own. And the star's ψυχή is so completely rational that the natural movement for it to cause is that which is most self-same, a rotation in which the star as a whole is always 'in the same place'. It is with special reference to this passage of the *Timaeus* that Aristotle is at pains to deny that any heavenly body has an axial rotation (*De Caelo* B. 290ᵃ 25 ff. ἀλλὰ μὴν ὅτι οὐδὲ κυλίεται τὰ ἄστρα φανερόν· τὸ μὲν γὰρ κυλιόμενον στρέφεσθαι ἀνάγκη, τῆς δὲ σελήνης ἀεὶ δῆλόν ἐστι τὸ καλούμενον πρόσωπον κτλ.). His principal argument is that the moon, if it rotated, could not always present the same surface to us, but we see that it does, since the so-called 'face' in the moon is always visible. This very fact to our minds proves that the moon *has* an axial rotation with the same period, or nearly so, as its revolution round the earth, but what Aristotle means is that the moon has no rotation relative to its orbit.

Martin points out that the argument should apply equally to the planets. He infers, as Proclus had done before him, that Plato means the axial rotation to extend to them. In that case, a planet will have *three* motions, its axial rotation, its revolution in the Zodiac, and its diurnal revolution. Since Timaeus never says a word about the third motion in the case of the planets, I think we are not entitled to read it into the dialogue.[2] It is not quite so clear as Martin and Proclus sup-

[1] Proclus ed. Diehl iii. 118 κόσμος δὲ ἀληθινὸς ἡ ἀπλανὴς γέγονε.

[2] Boeckh accepts the view of Martin and Proclus (*Kosmisch. System des Platon* 59). He is very positive about the point ('die Achsendrehung muss . . . auch auf Sonne, Mond und Planeten ausgedehnt werden'), but gives no reason. For the reasons given in the text I think the axial rotation 'muss' *not* be ascribed to the planets, but I confess that certainty is not attainable. If Plato had given the moon such a rotation, I should, however, have expected Aristotle, who thought otherwise, to have remarked on the point.

pose that he means to attribute individual *ψυχαί* to the *ὄργανα χρόνων*, and we are not at liberty to make his account of the world more consistent by supplementing it with arrangements of which his language gives us no hint. Proclus' argument that if a star has two motions, a planet, which is farther removed from complete 'unification' and nearer to 'multiplicity', should have more than two, is not convincing, since the planet, whether it has axial rotation or not, exhibits *τροπαί* from which the star is free, as is mentioned at 40 b 5–7.

40 b 1. *τὴν δὲ εἰς τὸ πρόσθεν*, motion 'forwards'. This does not mean a rectilinear progression, as though the stars would move along straight lines but for the interference of the circle of the Same. The motion called 'forward' is precisely circular revolution from E. to E. through W. in the sense of the diurnal revolution of the circle of the Same itself. It is called 'forward' because it is in the sense of that revolution, just as later writers, when they speak of the movements of the planets through the Zodiac, call movement *εἰς τὰ ἑπόμενα*, that is movement from one sign to the next in the order in which the sun traverses them from W. to E.; 'advance' and motion the other way *εἰς τὰ ἡγούμενα*, 'retrogression', because the one is with, the other against, the *principal* movement of all which take place through the Zodiac, the sun's annual motion. If the *κράτος* of the circle of the Same were eliminated, what would be left to the stars by the account of Timaeus is not rectilinear progress but the one motion of rotation on their axes.

40 b 2. *τὰς δὲ πέντε κινήσεις κτλ.* The five motions denied of the stars are of course motion *εἰς τὸ ὄπισθεν*, retrogression (i. e. in this case movement against the sense of the *daily* revolution), movement to the right or left (excursions in latitude), movement *ἄνω* and *κάτω* (i. e. for the case of the stars, variation of *βάθος*, apogee and perigee.)

40 b 4. *ἐξ ἧς δὴ τῆς αἰτίας.* A curious combination of the two constructions *ἐξ ἧς αἰτίας* and *ἐκ ταύτης τῆς αἰτίας*. For a full list and classification of such combined constructions in the dialogues see *Digest of Platonic Idioms* (appended to Riddell's edition of the *Apology*) §§ 204–30.

40 b 6, note that *στρεφόμενα*, 'revolving on axes', is here expressly contrasted with *τρεπόμενα*, 'going back on their steps', as *ἀεὶ μένει* is with *πλάνην τοιαύτην ἴσχοντα*. This certainly looks as if Timaeus definitely intends to confine axial revolution to stars as contrasted with planets.

40 b 8–c 1. *γῆν δὲ . . . τεταμένον.* These words have given rise to the most famous controversy ever raised about the interpretation of the *Timaeus*. Aristotle expressly understood them to assert the motion of the earth. Most of the ancient Platonists whose works we possess, living in a time when geocentric views had prevailed, naturally contrived to ascribe to Plato what they themselves held to be the true doctrine of the motionlessness of the earth. But Theophrastus, an exceptionally good witness, who had every opportunity of knowing what Plato's doctrine was, expressly credits him with believing in the earth's motion, and though Aristotle only says that *Timaeus* maintains the doctrine, I believe I shall be able to show that he definitely alludes to Plato, though without naming him, as personally holding the

theory. Even Cicero is aware that Plato had been supposed by some interpreters to teach the doctrine, though in language which might admit of a different explanation (*Academ. Prior.* ii. 123 'atque hoc'—viz. that the earth rotates on its axis—'etiam Platonem *in Timaeo* dicere quidam arbitrantur, sed paullo obscurius'). In the nineteenth century the question was the topic of a famous controversy between Grote and Aug. Boeckh, Grote definitely maintaining that the *Timaeus* teaches the earth's motion, and that the motion meant is an axial rotation with a period of twenty-four hours, Boeckh denying both propositions. Both unfortunately forgot that the question what Plato himself held and the question what view he meant to attribute to Timaeus are two different questions, not one.[1]

What I propose to show here is (1) that Plato believed in a motion of the earth, and that Aristotle actually refers to this fact; (2) that Timaeus also ascribes a motion to the earth; (3) that the motion in which Plato himself believed is quite different from that spoken of by the *Timaeus*; (4) that neither motion is an axial rotation. Boeckh was right in saying that the axial rotation of the earth is not to be found in the *Timaeus*, wrong in saying that no other motion is to be found there; Grote was right in finding a movement of the earth in the dialogue, wrong in supposing it to be an axial rotation. No apology is needed for discussing the whole subject in some detail. Plato is so important a figure in the history of science, and the question of the connexion of the Academy with the rise of the 'Copernican' astronomy is of such intrinsic interest, that it is well worth while to examine the evidence about Plato's own personal views. If we should find that they differ in a matter of first-rate moment from the views he has ascribed to Timaeus, this forms an *instantia crucis* in the controversy about the value of Plato's accounts of fifth-century teaching. Finally, if Timaeus, a fifth-century Pythagorean, is correctly represented by Plato as teaching that the earth moves, though he does not credit it, like the Pythagoreans described by Aristotle, with a revolution round a central luminary, we are clearly on the trend of something very ancient, and the question will at once arise

[1] Boeckh's view is best studied in the essay of 1852 *Über das kosmische System des Platon* pp. 59 ff., in reply to Gruppe, who also found the axial revolution of the earth in our passage. Boeckh has no difficulty in proving that this motion is not asserted by Timaeus, but as a proof that T. supposes the earth to be at rest, his argument is a simple *ignoratio elenchi*. He was also unaware of the true text of our passage, which has *τήν* before *τὸν δ. π. τεταμένον πόλον*. His attempt to get over the tense of *ἱλλομένην* by taking from Buttmann the explanation that 'the forces which make and hold together the cosmic system are thought of as continuously active' is a piece of special pleading which seems hardly to satisfy himself (see *op. cit.*, p. 65). He asks why, if the word means 'rotation', it is only used on this one occasion, though Plato has so many equivalent phrases, *περιφέρεσθαι*, *ἀνακυκλεῖσθαι*, &c.? The answer is that the word means an entirely different kind of motion. One might retort his question on him. If the word means 'rest', why does not Plato say *μένουσαν* or the like? He then quotes two instances where *εἱλούμενον* is correctly used (one of them *Tim.* 76 b, the other *Tim.* 86 e), mistranslates both (see my notes *in loc.*), and makes his own mistranslations 'massgebend' for the present passage. But even so, the sense of the word he arrives at is 'sich herumlegen in Kugelform', a phrase which would be an odd one to express 'absolute rest' (*op. cit.* 66–7.)

whether *a* doctrine of the earth's motion does not go back, as Eudemus held that it did, to the very first beginnings of Hellenic cosmology. For obvious reasons, I raise the questions which concern us in the order adopted above. (1) *Plato's own mind about the earth's motion.* I propose to consider first the external and then the internal evidence. (*a*) *External evidence.* There is in the first place an important statement of Theophrastus preserved to us by Plutarch. In the little collection of notes on points of Platonic scholarship known as *Quaestiones Platonicae* (*ζητήματα Πλατωνικά*), Plutarch says (1006 c), after mentioning the heliocentric astronomers, Seleucus and Aristarchus, that Theophrastus also informs us that Plato in his later years repented that he had given the earth the central position in the universe, to which it is not entitled (*τῷ Πλάτωνι πρεσβυτέρῳ γενομένῳ μεταμελεῖν ὡς οὐ προσήκουσαν ἀποδόντι τῇ γῇ τὴν μέσην χώραν τοῦ παντός*. Plutarch does not say from what work of Theophrastus his statement is taken, but it would be most natural to suppose that it is the great work *Περὶ φυσικῶν δοξῶν* where, as we see from Aetius *Placita* iii. 11–13, the questions whether the earth is 'at the centre' and whether it moves, were discussed. (Possibly we may infer from the tense of the *μεταμελεῖν* that Theophrastus wrote *Πλάτωνι μετεμέλει*, in which case we could argue that the use of the imperfect shows that Theophrastus was referring to actual oral knowledge, 'Plato used to express regret', but I would not lay too much stress on this.) There is another allusion to the same thing in Plut. *Vit. Numae* xi, where, however, the source of the information is not specified. Plutarch has been talking of the Pythagorean view that the earth is a planet which revolves round the 'central fire'. He goes on, 'it is said that Plato too in his later years (*πρεσβύτην γενόμενον*) held the same view that the earth is in a different region, and that the central and supreme place belongs to some other and worthier thing' (*διανενοῆσθαι περὶ τῆς γῆς, ὡς ἐν ἑτέρᾳ χώρᾳ καθεστώσης, τὴν δὲ μέσην καὶ κυριωτάτην ἑτέρῳ τινι κρείττονι προσήκουσαν*). The close verbal coincidences with the passage already quoted, shows that here, too, Plutarch has the same words of Theophrastus in his mind, and that the doctrine ascribed by Theophrastus to 'Plato in his later years' is that the earth is not at the 'centre' but moves[1] round some 'worthier thing' which occupies that place. Incidentally, it is thus already proved that the doctrine regarded by Theophrastus as Plato's is quite different from that which Grote found in the *Timaeus*, viz., that the earth is *at* the 'centre' and rotates there round the axis of the universe. Now the testimony of Theophrastus is far too weighty to be lightly set aside. As we have already seen, he was twenty-five or a year or two older when Plato died, and chronology thus bears out the statement that he had actually been a member of the Academy. Probably, then, it was in the Academy and from Plato's own lips that he heard Plato's views about astronomy. He was also the intimate associate and chosen successor of Aristotle, who must have known the true facts. In any case it is not a mere inference

[1] In neither passage does Plutarch expressly say that Plato was held to have attributed motion, as well as a non-central position, to the earth, but that this is meant is clear from the fact that in both cases the immediate context refers to doctrines of the earth's motion.

of his own from isolated expressions in the dialogues with which we are dealing.

This brings us to consider the testimony of Aristotle himself. Aristotle's statement is given in *de Caelo* B. 293ª 15 ff., and is so important that it must be quoted in full. 'We still have to treat of the earth, its position, whether it is at rest or in motion, and also of its shape. Now as to its position opinion is not unanimous. Most say that it is at the centre, that is, most of those who hold that the universe as a whole is bounded. But the Italians who are known as Pythagoreans tell a different story. At the centre, they say, is fire; the earth is one of the planets (ἓν τῶν ἄστρων), and causes day and night by its revolution round the centre. Further, they fabricate a second earth opposite to ours, which they call the Counter-earth (ἀντίχθονα), not looking for theories and causes which correspond to the appearances, but forcing the appearances to fit certain theories and fancies of their own and trying to adjust them (πειρώμενοι συγκοσμεῖν). Many others might agree in the view (πολλοῖς δ' ἂν καὶ ἑτέροις συνδόξειε) that we ought not to assign the central region to the earth, drawing their conviction not so much from the appearances as from (general) arguments (οὐκ ἐκ τῶν φαινομένων ἀλλὰ μᾶλλον ἐκ τῶν λόγων). For they think it appropriate (οἴονται προσήκειν) that the most honourable region should belong to the most honourable thing (τῷ τιμιωτάτῳ), and that fire is more honourable than earth, and the limiting position (τὸ πέρας) than the intermediate, and that the centre and the outermost surface (τὸ μέσον καὶ τὸ ἔσχατον) are limiting positions. So when they draw the consequences from these premisses, they think (οἴονται) that the earth is not placed at the centre of the sphere, but rather fire. The Pythagoreans have a further argument that it is fitting that what is supreme in the universe should be most carefully guarded, and such is the centre; so they call the fire which occupies this region the "guardroom of Zeus" (Διὸς φυλακήν) . . . This, then, is the opinion of some about the earth's position. Similarly as to its rest or motion. All do not hold the same opinion. Those who say it is not even situated at the centre hold that it revolves in a circle round the centre (κινεῖσθαι κύκλῳ περὶ τὸ μέσον), and not our earth only, but also the Counter-earth, as I have already explained. Some even hold that a number of such bodies may be revolving round the centre, though they are not visible to us as they are occulted by the earth. Indeed, they say this is why lunar eclipses happen more frequently than solar; the moon is shut off from the sun's light by any of these revolving bodies as well as by the earth . . . Also some say that the earth though actually at the centre (καὶ κειμένην ἐπὶ τοῦ κέντρου) "goes to and fro"—i. e. moves—"there about the axis which stretches through the universe", as it stands written in the *Timaeus* (ἴλλεσθαι καὶ κινεῖσθαι περὶ τὸν διὰ παντὸς τεταμένον πόλον, ὥσπερ ἐν τῷ Τιμαίῳ γέγραπται).'

Note that Aristotle is careful to distinguish two theories about the earth's motion. One is that it is *at* the centre and has there a motion of some kind signified by the word ἴλλεσθαι. This, he says, is what is written in the *Timaeus*. As to the kind of motion meant, he does not explain it; he merely quotes Plato's phrase, not *quite* accurately, adding

κινεῖσθαι as an equivalent for the rare poetical word ἴλλεσθαι, as though he were not himself quite sure what kind of movement is intended. The second view is that all the planets revolve *round* a centre which is occupied by a 'fire' or luminary (*not*, of course, the sun), and that the earth is one of them. *This* view, he says, is held by certain Italians popularly called Pythagoreans, and as he mentions that the revolution causes day and night, we see that it must have a period of twenty-four hours. In fact, it does the work of the axial rotation we ascribe to the earth, so far as effecting the alternation of day and night is concerned, but it is thought of as the revolution of a ring carrying the planet. Aristotle also speaks of certain other unnamed persons who agree with the view that the earth is not *at* the centre but revolves *round* it, and he gives the argument upon which these 'others' rely, which is clearly marked off from the argument of the Pythagoreans.[1] He gives as the argument of these unnamed 'others' precisely that ascribed by Theophrastus to Plato, that it is 'not proper' (οὐ προσήκει) that the earth should be the central thing in the universe; such a place belongs of right to a more 'honourable' occupant. The persons who are supposed to use this argument cannot be the Pythagoreans, since they are expressly distinguished from them twice over. Nor can Simplicius well be right in the view he advances in his comment on the passage, that Aristotle invented the argument merely to show that he could, if he pleased, make out a better case for the Pythagoreans than they had done for themselves, since Aristotle twice refers to what those who use this argument 'think' or 'do not think'. Clearly he means some actual persons who were not Pythagoreans, but agreed with the Pythagoreans in looking on the earth as a body which revolves round a certain luminary.[2] And the close verbal resemblance of the argument he ascribes to them (note the οὐ προσήκει, ταύτην τὴν χώραν, and the τιμιώτατον), with that ascribed by Theophrastus to Plato, seems to me to put it beyond reasonable doubt that it is Plato and those who accepted his doctrine whom Aristotle has in mind. The absence of Plato's name is exactly in keeping with Aristotle's common habit of introducing views which we can prove to be those of leading members of the Academy as the opinions of τινές. In the *Metaphysics*, it is hardly too much to say, a view ascribed to τινές regularly means an Academic theory.

If Aristotle means Plato a very important consequence follows. When he goes on to speak of the statements of the *Timaeus*, and distinguishes the doctrine of the dialogue that the earth moves *at* the centre from the other theory that it moves *round* the centre, he is discriminating the view of Timaeus from that of Plato, and is aware that the astronomy of the

[1] We see from other references in Aristotle that the argument he means to ascribe to the Pythagoreans in his disparaging remarks about them is that it is 'fitting' that since ten is the ἀριθμὸς τέλειος there should be just ten 'circles' in the heavens. The number is got by adding to the familiar eight one for the earth and another for the ἀντίχθων. The Pythagoreans had much better arguments than this both for holding that the earth is a planet and that there is an ἀντίχθων, but it suits Aristotle's purpose to lay special stress on this numerical fancy. He does not ascribe it to those whom he calls 'others'.

[2] Simplicius informs us that Alexander of Aphrodisias said in his lost exposition of the *de Caelo* that he did not know to whom Aristotle is referring. This shows that Alexander at any rate understood that the reference is definitely to some real person.

dialogue is not that which he knew as Plato's own. He is not going to the *Timaeus* for his information about *Plato's* own theories, and this may be why he says of the theory he quotes that it is what 'is written in the *Timaeus*'. For his knowledge of *Plato's* views he would depend not on dialogues at all, but on the recollection of twenty years of association in the pursuit of science. If Aristotle had been dependent on the *Timaeus* for his knowledge of Plato's astronomy, it would be quite arguable that he might be led astray in his interpretation of a rare poetical word like ἴλλεσθαι. But it is flatly impossible that he should have been in the Academy for twenty years without knowing for certain whether Plato taught the motion of the earth, or what sort of movement he assigned to it. If he really means Plato when he talks of some one besides the Italian Pythagoreans who said that the earth revolves 'round the centre', we may be certain that Plato really did say this. And we may further be sure that the doctrine was not suddenly adopted by Plato on the edge of the grave in a state of 'dotage'. If Plato had at the end of his life capriciously changed his mind on a point of such first-rate importance, Aristotle could hardly have been silent about such an inconsistency. It would have been a capital point in favour of his own geocentric views to urge that the most eminent man on the other side had only fallen into 'heresy' in the last weakness of extreme old age. I should infer, then, that Plato had consistently taught that the earth is a planet during the twenty years of Aristotle's connexion with him in the Academy, that is, from his own sixtieth year, and may have held the doctrine even earlier. The words of Theophrastus are quite consistent with this view. He does not say that Plato adopted the theory that the earth is a planet 'in extreme old age', but merely πρεσβύτερος γενόμενος, 'when he had got into years', language which is quite applicable to a man of sixty or even less. (At Athens, we may remember, a man became officially a γέρων and immune from public service at sixty.) As for the 'repentance' of which Theophrastus speaks, it is sufficiently explained by the myths of the *Phaedo* and *Republic*, written long before Plato was sixty, where the central position and immobility of the earth are assumed.

(*b*) *Internal evidence.* When we turn to Plato's own works for confirmation of the evidence of Aristotle and Theophrastus, we get it at once in the passages of the *Laws* and *Epinomis* I have already had more than one occasion to cite. When the Athenian speaker at *Laws* 822 a insists on the point that every planet has one and no more than one uniform real movement (οὐ πολλὰς ἀλλὰ μίαν ἀεὶ κύκλῳ), he must, of course, mean that the rest of the 'apparent' motions are only apparent, and the only way to maintain this is to hold that they are really due to the motion of the earth and its inhabitants. If each planet is to have just one movement, all the movements it seems to have except that one must be transferred, with a reversal of sense, to the earth from which we make our observations. And it is further clear which is the one that must be left to the planet itself; it is the movement through the Zodiac. No 'motion of the earth' will account for the very different periods in which the planets go round the Zodiac. But the 'diurnal motion' of all the contents of the heavens may be replaced by a diurnal motion of the

earth in the opposite sense from W. to E. That this is Plato's meaning is clear from the statement of the *Epinomis* that the outermost circle does not really 'carry round' the others with it. With a non-revolving earth the 'double motion' of the planets is indispensable to account for the facts already known to Timaeus. The circle of the Same *must* 'carry round' the rest. It follows that when Plato says this does not happen, he must be meaning to transfer the diurnal motion to the earth. It does not, however, follow that the implied motion of the earth is an axial rotation. It is much more probable that Plato, like the Pythagoreans, held that the earth as an inner planet revolves round the central fire in a period of twenty-four hours. The system is, of course, not heliocentric, since the *Epinomis* still speaks of the sun as having his annual period; sun and earth alike must have a real motion round the 'more worthy thing' which is 'at the centre', the so-called 'central fire'. The only way to get an axial rotation in would be to think of this fire as itself a shaft of light passing right through the earth and forming the axis of the universe, and the analogy of Plato's theory with the view ascribed by Aristotle to the Pythagoreans is definitely against such an interpretation. A further consequence is that the real motion of the 'eighth circle' counter to the other seven, which is still retained in the *Epinomis*, can no longer have anything to do with night and day. Its period, therefore, will not be twenty-four hours, as in the *Timaeus*. What the period is, Plato does not say, and it is not necessary to suppose that he had any definite doctrine on the point. Nor is it clear what 'appearances' the motion of this circle is now supposed to account for, except that it can have nothing to do with 'precession', since it is in the wrong sense for that. Nor, again, have we any hint of the way in which Plato himself proposes to explain the 'anomalies' of the planets. Since the period of the earth's revolution must clearly be twenty-four hours, it is no good to invoke that movement in explanation. The words of the *Laws* should imply that these 'anomalies' are also only 'apparent'. To some extent, no doubt, they could be accounted for by remembering that we see the paths of the planets from a position which is 'out of the centre', but they would necessarily remain in their detail unexplained until the central luminary round which the orbits are described was identified with the sun. My own conjecture is that Plato saw that the neat and ingenious scheme of Eudoxus was based on an erroneous assumption, and preferred putting forward no detailed 'theory of the planetary movements' to constructing an apparently plausible one upon a vicious foundation. That, if this was Plato's judgement, he judged rightly is shown by the whole subsequent history of planetary theory. For all the elegance of the Eudoxian scheme it had to be 'scrapped' in principle by the Alexandrian astronomers who introduced 'eccentrics' and 'epicycles'. What was amiss was precisely the assumption that the earth could be treated as 'at the centre' of a planet's orbit. It would have been better in the end for astronomical science if in the fourth century others besides Plato had recognized that no satisfactory solution of Plato's problem can be obtained without putting some 'more suitable body' at the centre, and had never made the premature attempt to 'save the appearances' on the Eudoxian lines. If that

had happened, Aristarchus might have come by his rights without having to wait for the best part of two thousand years.

(2) Next, as to the view Plato means Timaeus to be expressing. Aristotle held that Timaeus means to say that the earth is 'at the centre' and has there a motion indicated by the word *ἰλλόμενον*. What this motion is Aristotle does not say, and *perhaps* did not know, but he makes it clear by his distinction between moving 'round the centre' and moving 'at the centre' that he did not suppose it to be an orbital 'revolution'. Careful scrutiny of Plato's text will show that Aristotle's interpretation is the only possible one, though in his passing allusion to the phrase of Timaeus he happens not to quote the absolutely decisive word, the *τήν* after *ἰλλομένην δέ*. It is this word which, even if *ἴλλεσθαι* itself occurred only in our passage, would be enough to prove that motion of some kind is meant. The word appears to have been restored to the printed text for the first time by Bt., but Bekker duly recorded *τήν* as the reading of A in his collation, and it appears also in the notes of Bast's collation printed by Stallbaum at the end of his edition of our dialogue. The absence of *τήν* from FY and from Plutarch's quotation of the passage counts for nothing. It was sure to be dropped when the doctrine of a central immobile earth had become a universal dogma; that it should have been illegitimately foisted into the text of A or the archetype of A, on the other hand, would be perfectly inexplicable. The word is an accusative of 'space through which', and there is an ellipsis of *ὁδόν* as in phrases like *τὴν ταχίστην, τὴν εὐθεῖαν, τὴν ἐπὶ θανάτῳ*. Thus the sense is 'on the path about the axis of the universe', and this, of itself, implies that the earth is moving and that the participle following is that of a verb of motion. As to *ἰλλομένην* itself, those who want to get rid of the earth's motion have to suppose one of two things, that it is a corruption of *εἰλουμένην*, which they take to mean 'rolled up into a coil', 'globed round' the axis, or that Timaeus is confusing the words *ἴλλεσθαι* and *εἰλεῖσθαι*. They have also to suppose that Aristotle, consciously or not, has misrepresented the meaning of the word. None of these suppositions will stand examination. As for the text the reading *ἰλλομένην* is really that of the only MSS. of the Timaeus which count. The variant *εἰλλομένην* or *εἰλλομένην* (A and P) is merely a misspelling due to the standing tendency of all but our oldest MSS. to represent *ι* by *ει*, even where the *ι* is short. (Thus we get such spellings as *Παρμενείδης, εἰδέα* in the Bodleian codex of Plato.) For *εἰλουμένην* there is really no MSS. authority at all. *ἴλλεσθαι* is also the best attested MSS. reading in Aristotle's references to the passage (*de Caelo* B. 293^{b} 31, 296^{a} 26) and is Plutarch's quotation. Further, Aristotle twice adds *κινεῖσθαι* as an explanation, *de Caelo* B. 293^{b} 31 *ἴλλεσθαι καὶ κινεῖσθαι*, 296^{a} 26 *ἴλλεσθαι καὶ κινεῖσθαι*. (There is some doubt about the genuineness of the *καὶ κινεῖσθαι* in the former passage, but apparently none whatever about the second.[1]) Further it is fatal to the proposal to read *εἰλουμένην* or to sup-

[1] Boeckh (*Kos. System des Platon* 83) actually maintains that Aristotle is not criticizing the doctrine of Timaeus at all. He borrows the words *ἴλλεσθαι* and *περὶ τὸν . . . πόλον* from Plato, but he is applying them to the doctrine of some unnamed persons who taught an axial rotation which, as he himself knew, was not to be found

pose that Timaeus confuses that word and ἰλλομένην, that the tense of the participle is wrong. Conceivably the *perfect* participle of εἱλεῖσθαι might be used in the sense of 'globed into a ball', but the *present* could only mean 'coiling round', and such a meaning is quite out of place here, even if the τήν did not make a verb of motion necessary. We have also the testimony of Aristotle to reckon with. The notion that Aristotle consciously misrepresented the *Timaeus* for polemical purposes may be set aside at once. Even if we are prepared to believe, as I am not, that Aristotle was capable of such dishonesty, we must remember that until years after Aristotle's death the Academy was presided over by Xenocrates, an immediate disciple of Plato, and both Academy and Lyceum contained other members who had been Plato's personal associates; misrepresentation on a point like that of the motion of the earth would thus have been suicidal. It remains to consider whether Aristotle may have been genuinely mistaken. As we have seen, grammar itself demands a verb of motion, and moreover the usage of the word ἴλλεσθαι does not really leave room for misinterpretation.[1] The verb is regularly used of movement 'up and down' or 'to and fro', as in Sophocles *Antig.* 340 ἰλλομένων ἀρότρων ἔτος εἰς ἔτος, 'as the plough goes up and down', cf. Aristotle *Meteorologica* B. 356[a] 5, where the form εἱλεῖσθαι is used with the same sense, περὶ τὸ μέσον εἱλεῖσθαι. (Aristotle is speaking of the account of the 'subterranean rivers' in the myth of the *Phaedo*, and says correctly that they 'oscillate up and down' about the 'centre'. The traditional rendering *revolvi* will not fit the sense. What Aristotle has in mind is the 'swaying' movement called in the *Phaedo* itself an αἰώρα (*Phaedo* 111 e 4 ταῦτα δὲ πάντα κινεῖν ἄνω καὶ κάτω ὥσπερ αἰώραν τινὰ ἐνοῦσαν ἐν τῇ γῇ). It is this that he means when he writes οὐ ἔχειν γὰρ ἕδραν ἀλλ' ἀεὶ περὶ τὸ μέσον εἱλεῖσθαι.[2] The sense is then that the earth goes 'up and down' or 'to and fro' on a track 'about the centre'. This does not suggest complete revolution in an orbit, which would not have the reversals of 'sense' apparently implied by the word. What it suggests is rather that the earth 'makes excursions' alternately on either side of the 'centre', and this seems to be at the bottom of Aristotle's careful distinction between the doctrine of Timaeus that the earth moves 'at the centre' and that of others who say it moves 'round the centre'. To us, the sort of motion naturally suggested by such a phrase would be that of a pendulum executing oscillations in circular arcs, but it would be

in the *Timaeus* at all. This is more respectful to Aristotle's character than the rival view of M. Martin and Sir T. L. Heath that Aristotle consciously lied (*Aristarchus* p. 178), but one wonders whether Boeckh can have quite believed his own explanation. He admits that it will probably be called Künstelei—as it certainly is—but pleads that it is gute Künstelei, a point on which the inventor of the device is perhaps not the most competent judge.

[1] As Simplicius tells us, Alexander of Aphrodisias, with his usual honesty and sense, remarked that it is absurd to suppose that Aristotle did not know what Plato meant by ἰλλομένην, and that consequently we must take it as certain that motion of some kind is meant (ἀλλὰ τῷ Ἀριστοτέλει, φησίν, οὕτω λέγοντι ἴλλεσθαι, οὐκ εὐλόγον ἀντιλογεῖν· ὡς ἀληθῶς γὰρ οὔτε τῆς λέξεως τὸ σημαινόμενον εἰκὸς ἦν ἀγνοεῖν αὐτὸν οὔτε τὸν Πλάτωνος σκοπόν).

[2] Ought we not to write ἴλλεσθαι here? Cf. the discussion of our passage in *EGPh.*[2] 301–5, to which I am deeply indebted.

an anachronism to find the pendulum in a speech put into the mouth of a fifth-century Pythagorean. We must rather therefore think, with Bt., of periodical rectilinear displacements along the 'axis' of the universe in opposite senses and about the 'centre' (*EGPh.*[3] 301–5). Note that nothing is said here of the 'worthier body' as occupying the 'centre'. Except when the earth happens to be just passing the 'centre' in its excursions, the 'centre' will be empty. The non-existence of any 'central' luminary is also implied by what Timaeus has already told us of the purpose for which God made a 'light' in the second circle. If there were already a 'central fire', the circles could have 'seen their way' without the sun. It is precisely the absence of any central luminary which Aristotle rightly regards as distinguishing the astronomy of Timaeus from that of those who regard the earth as a 'planet' (ἓν τῶν ἄστρων). We further see that Timaeus is really not guilty of the absurdity into which Boeckh held he must fall if he ascribed a motion to the earth, viz. that this motion would clash with his former statement that the periodical revolution of the circle of the Same in twenty-four hours causes the alternation of day and night. Of course there would be this clash if the motion given to the earth is an axial rotation with the same period of twenty-four hours. If the rotation were in the same sense as the revolution of the Same, you would get no alternation of day and night at all; if it were in the opposite sense, the νυχθήμερον should be half its actual length. Grote admitted this absurdity, but strangely supposed that Plato might have overlooked it.[1] The speculation is not meant to account for day

[1] Grote *Minor Works* pp. 243–6. Grote argues that if Plato overlooked the point we must not be surprised, for (1) Aristotle clearly overlooked it also; (2) by Boeckh's own admission, no commentator before himself had attended to it; (3) the Pythagoreans who taught the doctrine of the 'central fire' also forgot that the revolutions of ἀπλανές, planets, earth, 'annulled' one another 'as to effects'. There is a bad confusion here. The criticism would only really affect a theorist, if there were one, who gave the earth and the ἀπλανές alike a movement *in the same sense* and with the same period of twenty-four hours. It would not affect any one who made ἀπλανές and earth revolve in the same period but in contrary senses. He would only have to suppose that the 'real' period of both revolutions is forty-eight hours, and the phenomenon of the twenty-four hours interval between one transit of a star over the meridian would be 'saved'. Still less would such a criticism tell against Timaeus, who does not ascribe a revolution to the earth at all. Hence there is no ground for accusing either Aristotle or the Pythagoreans of the supposed oversight. It is really both Boeckh and Grote who make a blunder by forgetting that the conditions under which a revolution of the earth would cancel out a revolution of the ἀπλανές are excluded by T.'s adherence to the theory of the opposition in sense between the revolutions of ἀπλανές and planets. Grote's own theory of T.'s meaning is hopelessly incoherent. He supposes that the revolution of the ἀπλανές is due to a rotation of the axis of the universe, which is a solid cylinder; the earth is attached to this axis and 'regulates' its motion, and consequently revolves with it. I may be merely dull, but I do not understand the mechanics of this process at all. If the earth moves along with the supposed cylinder, how does the earth act as a break or regulator? Grote says (*op. cit.* 248–9) that if there were any friction between the earth and the cylinder, this would correct all the cosmic motions. But if there is not such friction, how is the 'regularizing' done? Grote seems to have two incompatible ideas in his head at once. (1) The revolution of the cosmic axis *causes* the revolution of the earth ('if the cosmical axis is to revolve, the earth, being closely packed and fastened round it, must revolve along with it', *op. cit.*, p. 248, cf. p. 261): (2) the earth '*keeps up and regularizes*' the movement of the axis (ib. 249). Of course it follows that Grote must suppose the sense of the

and night. What 'appearances' it is meant to 'save' we are not told, but must discover, if we can, for ourselves. Now obviously if the movement intended is a 'slide' alternately N. and S. along the axis of the universe, this might account for, at any rate, some of the apparent 'excursions in latitude' of the planets. We might suppose that a planet does not really make an excursion to the N. of the median plane of the ecliptic; it is we who have taken a slide to the S. of the 'centre'. This is Bt.'s suggested explanation of the purpose of the motion,[1] and since Timaeus recognizes the movements of the planets *κατὰ πλάτος* as one of the 'appearances', I feel no doubt that, so far as it goes, the explanation is correct. Of course it is obvious that as a complete solution of the problem raised by the planetary 'anomalies' the theory will not carry us very far. The effect of such a 'slide' ought to be a displacement of the whole visible 'heavens' in the opposite sense. Hence it will not account for the individual differences between the 'excursions' of the various planets, e.g. it will not explain why all do not attain their maximum N. or S. displacement simultaneously. And, as the 'slide' of the earth *can* only be N. or S., it will not throw any light at all on 'station' and 'retrogradation'. However, it is not necessary that the theory should work out completely, as Bt. has rightly said. Since Timaeus himself says nothing about the amplitude or period of the earth's excursions, we may presume that he is not supposed to have worked out any detailed theory. All that is necessary is that he should suppose that some of the apparent irregularities would disappear, if the earth is credited with a sliding movement N. and S. along the universal 'axis'. Some of the sun's 'anomalies', real or supposed, might be explained along these lines, and these are just the fact that would be felt to demand explanation first and foremost. There is also another set of appearances which we know to have attracted attention quite early which may come in. Why do we not see so many solar as lunar eclipses? This question had been raised at the very beginning of Greek astronomy, since it was obviously to answer it that Anaximenes said that the moon is eclipsed by certain invisible 'dark planets' (R.P. 28, *EGPh.*[3] 78). Similarly Aristotle explains at *de Caelo* B. 293[b] 21 that this was the real origin of the doctrine of the *ἀντίχθων* *EGPh.*[3] 305). There is no room in Timaeus's scheme for invisible

earth's rotation to be the same as that of the *ἀπλανές*, thus tacitly assuming the condition of 'cancelling out' of the two movements which he has forgotten to supply explicitly. But it ought to be clear that Timaeus does not conceive of anything except the outermost circle—the *ἀπλανές*—as having the movement *ἐπὶ δεξιά* ascribed to the 'Same', so that the assumption is not justified. He is right, on the other hand, when he says that on Boeckh's theory that the earth opposes to the diurnal movement an equal force in an opposite direction, there would be no movement of the *ἀπλανές* at all. He forgets that unless the earth, on the interpretation of T.'s cosmology adopted by himself, opposed some force to the diurnal motion, it could not 'regularize' that motion. Boeckh's rejoinder (*Kl. Schriften* iii. 294–320) corrects some of these errors, but adds nothing fresh in support of his own interpretation. The words *εἴλλω, εἰλέω, ἴλλω* and their cognates have recently been discussed by K. Burdach (*Neue Jahrbücher für das Kl. Altertum* xlix, pp. 254–78). Boeckh's interpretation is defended, but the *τήν* is ignored, and Aristotle is supposed to have been misled by a misspelling! (M. Rivaud prints *τήν* in his text, but translates and interprets as though the word were not there.)

[1] *EGPh.*[3] 304.

planets or for an *ἀντίχθων*, but his speculation about the earth may be intended to explain, among other things, why we do not see a total eclipse of the moon at every full moon and a total eclipse of the sun at every new moon. If the earth 'slides' on the axis of the whole, it may often happen that it is 'out of the centre' at these times, and then there is no eclipse or only a partial one.

If we look back over the whole early history of Greek cosmological ideas, we shall see, I think, that the theory which we have ascribed to Timaeus is strictly in the line of the natural development. Anaximander, the first known author of anything like a cosmological system, was recorded by Eudemus to have taught that the earth 'moves', and we have seen what the motion must have been. It must have been that of a rotating disk, or of a cart-wheel, revolving round an axis perpendicular to its surface and passing through its centre. We also saw that this view presumably persisted in the Milesian school, since it reappears with Anaxagoras, who brought Ionian science to Athens, in his doctrine that the sun and moon are fragments which have been detached from the earth by its 'revolution'. The recognition of the spherical shape of the earth was incompatible with the retention of this view in its original form. Two modifications of it then present themselves as both feasible. The earth may be regarded as a motionless sphere in the middle of the universe. This is the view adopted in the myth of the *Phaedo* and foreshadowed by the doctrine of Empedocles, that the earth is kept from falling by the violence of the revolution of the 'heavens' round it.[1] The other is the doctrine known to Aristotle as Pythagorean, that the earth is itself a planet revolving with the rest round a central luminary. The one view leads up through Eudoxus to Hipparchus and Ptolemy, the other to Aristarchus and Copernicus. Either development arises naturally when the old disk and cart-wheel conceptions have to be abandoned, and neither is reached all at once. The speculation of Timaeus, which gives the earth a motion without making it a planet, is manifestly a cruder form of the development which keeps to the moving earth than the theory called by Aristotle Pythagorean. Hence it is quite likely that it represents a half-way stage on this line of thought which had actually been reached in early Pythagorean speculation, and very unlikely that it has been invented for Timaeus by Plato himself, who must definitely have believed in the planetary character of the earth. There is, in fact, a close affinity between the theory and that of Empedocles, whom Timaeus follows so closely in many matters. Empedocles said that the earth is kept from slipping out of its place by the violence of the *δίνη* round it. (This does not exclude the possibility that it is turning round *in* its place, though more slowly than everything which is farther away from the centre of the eddy.) Now let us suppose that the violence of the *δίνη*, though great,

[1] Aristot. *de Caelo* B. 284^{a} 24 *οὔτε διὰ τὴν δίνησιν θάττονος τυγχάνοντα φορᾶς τῆς οἰκείας ῥοπῆς ἔτι σώζεσθαι τοσοῦτον χρόνον, καθάπερ Ἐμπεδοκλῆς φησιν* (where the reference is to the 'heavens' not falling on the earth); ib. 295^{a} 16 *οἱ δ' ὥσπερ Ἐμπεδοκλῆς, τὴν τοῦ οὐρανοῦ φορὰν κύκλῳ περιθέουσαν καὶ θάττον φερομένην τὴν τῆς γῆς φορὰν κωλύειν, καθάπερ τὸ ἐν τοῖς κυάθοις ὕδωρ* (R. P. 170 f.); Plato *Phaedo* 99 b 6 *ὁ μέν τις* (sc. Empedocles) *δίνην περιτιθεὶς τῇ γῇ ὑπὸ τοῦ οὐρανοῦ μένειν δὴ ποιεῖ τὴν γῆν* (all cited at *EGPh.*^{3} 237 a 3).

is not quite as great as Empedocles believed. Then, it might be thought, though the earth does not 'fall', it slips a little in either direction to slip back again in the other. This would give us the very movement Timaeus seems to mean, and might be thought to account for some at least of the planetary 'anomalies'. In this way the views of Timaeus about the behaviour of the earth fall into line with the general character of his doctrine as Pythagoreanism deeply influenced by Empedocles. Whatever may be thought of this suggestion, the important point to understand is that the motionless earth is not the starting-point of Greek cosmology, and that *in the fifth century* it was not yet the established 'orthodoxy' that the earth is motionless. We can see pretty well that it was precisely the brilliant promise of the Eudoxian hypothesis in the fourth century which really for the first time gave plausibility to the conception of an unmoving earth. Before Eudoxus, the well-known 'anomalies' must have seemed to astronomers to tell strongly in favour of the other view.

It is interesting to observe how long a tradition of the true exegesis of our passage lingered on in the minds of commentators who were themselves wedded to the doctrine of the earth's immobility. No doubt Aristotle's interpretation of the passage was felt as at any rate something which had to be refuted. Thus Chalcidius renders ἰλλομένην, as though it were εἰλουμένην, by *constrictam* (ignoring the tense of the participle; it does not follow that he actually *read* εἰλουμένην).[1] Yet in his commentary (§ 122, Wrobel, p. 187) he gives the alternative explanations *uel iuxt Pythagoram ignem* (*? igneum*) *uertentem se circum axem* and *medietati mundi adhaerentem quiescere terram*. He calls the latter view *aliquanto uerisimilius*, but only on the ground that the words of *Phaedrus* 247 a that Ἑστία 'stays at home', seem to refer to the immobility of the earth. Apparently he leaves it to the reader to choose either interpretation as he pleases, though in the next section he mistakenly gets the immobility of the earth out of the words about night and day. Proclus is more hardened. He inaccurately explains ἰλλόμενον, like so many moderns, by saying (Diehl iii. 136) συνέχεται καὶ σφίγγεται, and goes on to accuse Aristotle of a downright error. His arguments, however, amount to very little. He appeals, like Chalcidius, to the *Phaedrus* and also to the myth of the *Phaedo*, which, however, prove nothing relevant to the point, and further to the εἰλλόμενον of *Tim.* 76 c 1 (see note *ad loc.*), which he takes for the same word as ἰλλομένον. Also he quotes *Timaeus Locrus* 97 d γᾶ δ' ἐν μέσῳ ἱδρυμένα ἑστία θεῶν, which is of no authority at all. To meet the objection that the doctrine of the earth's motion was certainly entertained in the Academy, since it was said to be held by Heraclides of Pontus, he denies without producing any grounds for his denial, that Heraclides was an ἀκουστής of Plato (iii. 138).[2] Finally he makes an

[1] Cicero also renders 'quae traiecto axe sustinetur', which shows that he also supposed no motion to be intended, but is not admissible as a *translation* either of ἰλλομένην or of εἰλουμένην.

[2] Presumably Proclus only means to suggest that Heraclides was not a member of the Academy during Plato's lifetime. But even this conflicts with the inclusion of his name among the μαθηταί of Plato by the Alexandrian authors on whom Diogenes Laertius' *Life* of Plato is dependent, and on the mention of him along with Aristotle, Speusippus, Xenocrates, and Histiaeus as one of the auditors who published notes of

objection of his own, which has a certain acuteness, that if the earth has a proper motion this ought to have been allowed for, as it is not, by Timaeus in his statement about the τελεὸς ἐνιαυτός. This is, no doubt, true, but the omission only shows, what is apparent enough from many places in the dialogue, that Timaeus has not a finished 'system of universal knowledge'. There is a want of adaptation of his views about the great year to his views about the movement of the earth. In other words, he is engaged on the working out of a science which is progressive, and that is all. I do not propose to discuss here the stories about the Pythagoreans Ecphantus and Hicetas, who are said to have taught the axial rotation of the earth (or rather, as it seems, its 'revolution' in twenty-four hours round the axis of 'the whole'). Cicero (*Academica Pr.* ii. 39. 123) and Aetius (*Placit.* iii. 9. 2, *Doxogr.* 376) are our informants about Hicetas, and Cicero names the source of the statement, Theophrastus. For Ecphantus we have statements by Aetius (*Placit.* iii. 13. 3, *Doxogr.* 378) and Hippolytus (*Philosoph.* i. 15, *Doxogr.* 566), which means that the common source is again Theophrastus. Theophrastus then named both Hicetas and Ecphantus in the work Περὶ φυσικῶν δοξῶν. This seems good proof that both are real persons. Presumably they were mentioned as preceding Heraclides in teaching the doctrine that the 'diurnal revolution' really belongs to the earth. This, as we have seen, is not the doctrine of Timaeus, though it is that adopted tacitly by the Athenian of the *Laws* and *Epinomis* and held by the Pythagoreans whom Aristotle describes. Since the *Laws* (821 e) speaks of the doctrine as something new (οὔτε νέος οὔτε πάλαι ἀκηκοώς), it is tempting to suppose that, after all, it belongs to the revival of Pythagoreanism by Archytas and his friends. It is noteworthy that neither in the fifth nor in the fourth century do we get any indication of the doctrine of Aristarchus that the apparent annual revolution in the ecliptic is due to a real movement of the earth. That, of course, presupposes the identification of the 'central' luminary with the sun.[1]

Plato's lecture on the *Good* (Simplicius *in Aristot. Physica* 203ª6). Proclus himself relates in this very commentary on the authority of Heraclides himself that Plato had commissioned him to procure the poems of Antimachus of Colophon (*op. cit.* ed. Diehl i. 90), and Suidas has preserved a notice according to which he was left formally at the head of the school during Plato's absence at Syracuse in 367–6.

[1] It is true that Cicero's account makes Hicetas assert 'caelum solem lunam stellas, superaque omnia stare, neque praeter terram rem ullam in mundo moveri'. But he is obviously speaking carelessly. The reference must be to the 'diurnal revolution'. No one could have got out of *all* the movements of the planets by transferring them to the earth. The earth is said in Cicero's report 'circum axem se moveri'. I take 'axem' here to mean the axis of the οὐρανός, and the movement meant to be what Aristotle calls the earth's revolution round the central fire. As for Ecphantus, the statement of Hippolytus (loc. cit.) that the earth's movement is πρὸς ἀνατολήν shows that it is the 'diurnal revolution' which is meant. What Aetius says (*Placit.* iii. 13. 3, *Doxogr.* 378) is that Ecphantus and Heraclides made the earth move τρεπτικῶς τροχοῦ δίκην ἐνηξονισμένην ἀπὸ δυσμῶν ἐπ' ἀνατολὰς περὶ τὸ ἴδιον αὐτῆς κέντρον. τρεπτικῶς seems to me corrupt here; should we not read ⟨σ⟩τρεπτικῶς? The rest means 'like a wheel in its axle, from W. to E. about its own centre'. This, again, is simply the 'diurnal' revolution. There seems to be no suggestion of explaining the paths of the sun and planets through the Zodiac by a 'real' motion of the earth. Thus the theory once more is exactly that assumed in the *Laws* and described by Aristotle as Pythagorean,

40 C 1–2. φύλακα καὶ δημιουργὸν νυκτός τε καὶ ἡμέρας. The words do not, as Grote thought, imply the axial rotation or any other movement of the earth. It is not by the sliding movement on the 'axis' that the earth is the 'guardian and artificer of night and day'. The reference is to the discovery that what we call night is only the shadow of the earth. The older view was that darkness is either a sort of mist or exhalation rising from the surface of the earth or water, or a cloud that comes down from the sky. It was a discovery of the fifth century that night is not a cloud or fog but the shadow thrown by the earth itself. Empedocles, whom Timaeus so often echoes, thought it worth while to say so explicitly, and he is the first writer known to us who says it.[1]

Empedocles must have been led to this by his other discovery that moonlight is reflected sunlight.[2] As Proclus correctly explains, Timaeus means simply that if there were no earth to cast a shadow, there would be no night. This is true independently of all theories about the motion or immobility of the earth.

40 C 2–3. πρώτην . . . γεγόνασιν, i. e. 'oldest and most venerable of the gods who have *come to be*'. There is a still 'older and more venerable' God, the Creator Himself, but of Him it could not be said that He *γέγονε*. The phrase does not, I think, refer to anything in the narrative of Timaeus. He has said nothing which implies that the earth is 'older and more venerable' than the planets. The allusion is rather to theogonies or cosmogonies which started with Earth as one of their primitive beings and made other 'gods' her offspring. E. g. Hesiod *Theogony* 116 *ἦ τοι μὲν πρώτιστα Χάος γένετ' αὐτὰρ ἔπειτα | Γαῖ' εὐρύστερνος, πάντων ἕδος ἀσφαλὲς αἰεί* κτλ., where Chaos, Earth, Tartarus, and Eros are put together at the very beginning of things, Pherecydes Fr. 1 (*Fr. d. Vors.*[3] ii. 212) *Ζὰς μὲν καὶ Χρόνος ἦσαν ἀεὶ καὶ Χθονίη*, Pindar *N.* vi. 1 *ἓν ἀνδρῶν, | ἓν θεῶν γένος· ἐκ μιᾶς δὲ πνέομεν | ματρὸς ἀμφότεροι.* The allusion thus prepares us for the sarcasms about the theogonies which follow. The main point is that 'old and venerable' as Gaia is she is only part of what 'has come to be', *ἐντὸς οὐρανοῦ γέγονε*. The tone of respect is quietly ironical. Probably there may also be an intentional suggestion of the identification of Earth with Ἑστία (as at *Phaedrus* 247 a). Since those who believed in the 'central fire' called that Ἑστία as well as Διὸς *φυλακή* and Διὸς οἶκος, the words seem once more to imply that there is no 'central' fire in Timaeus' scheme. It is worth noting that in the very last sentence of the fragment of the *Critias* we get the Διὸς οἶκος (*Critias* 121). We are told there that Zeus called the gods together to a council in their most honourable dwelling, which stands at the centre of the

of a daily revolution of the earth round a centre, except that the words *περὶ τὸ ἴδιον αὐτῆς κέντρον* suggest that the 'central fire' has now been located inside the earth, and the revolution thus becomes exactly an 'axial rotation'.

[1] It is worth noting, as evidence, that the earth was originally thought to be going round in the δινή, that even in the third century or later it had not been quite forgotten that the earth contributes to the cosmic music, *γαῖα μὲν οὖν ὑπάτη τε βαρεῖά τε μέσσοθι ναίει*, Alexander (? Aetolus) *ap.* Theon. 140. 5 (Hiller). This is clearly the original view, as it is based on Anaximander's cosmology.

[2] Empedocles Fr. 48 (*Fr. d. Vors.*[3] i. 244) *νύκτα δὲ γαῖα τίθησιν ὑφισταμένη* (Diels *ὑφισταμένοιο*) *φάεσσι.*

universe and overlooks all nature (*εἰς τὴν τιμιωτάτην αὐτῶν οἴκησιν, ἣ δὴ κατὰ μέσον παντὸς τοῦ κόσμου βεβηκυῖα καθορᾷ πάντα ὅσα γενέσεως μετείληφεν*). It must be confessed that, in spite of what has been said in favour of the view that the 'central fire' belongs to the fourth century, this looks suspiciously like an allusion to it.

40 c 3–d 3. χορείας δὲ . . . πόνος. The sentence is a difficult one in several ways. We have first to fix the precise text according to the weight of testimony, then to satisfy ourselves of the precise grammatical construction and punctuation, and finally to interpret, if we can, the technical terms of astronomy employed. As to the text we have to consider (1) the [*περί*] bracketed by Bt., after Ast, (2) the choice between *προχωρήσεις* and the *προσχωρήσεις* of the MSS., (3) the retention or omission of the *οὐ* with *δυναμένοις*, (4) the choice between *διόψεως* and *δι' ὄψεως*, (5) that between *αὐτῶν* and *αὖ τῶν*. In the first instance, we should try to settle all these points if we can by appeal to testimony, though it will be impossible to decide some of them satisfactorily without taking into account the exegesis of the passage.

(1) As to [*περί*]. The word presents grave grammatical difficulties. It seems to have no intelligible construction, whereas, if we omit it, we get a natural and simple one, *ἐπανακυκλήσεις* and *προχωρήσεις* or *προσχωρήσεις* being, like *χορείας* and *παραβολάς*, accusatives of the direct object after *τὸ λέγειν* of d 2. Cicero ignores the word in his rendering *flexiones autem deorum et inter ipsos deos concursiones, quaeque in orbibus eorum conversiones antecessionesque eveniant* (= *καὶ τὰς τῶν κύκλων πρὸς ἑαυτοὺς ἐπανακυκλήσεις καὶ προχωρήσεις*). Chalcidius also takes no account of the *περί* in his rather florid paraphrase, *stellarum uero choreas et alterius* adplicationes ad alteram (*καὶ παραβολὰς ἀλλήλων*), *uariosque gyros quos edunt admirabili*[1] *uenustate iuxta ambitus circulorum, reditusque et anfractus ad eas sedes ex quibus progressae sunt, accessus etiam et recessus.* Proclus has the word, but comments as though he meant to be explaining a reading ⟨*τὰ*⟩ *περί*. In view of the version of Cicero, I think it clear that we should either delete the *περί* or, and this is perhaps better, insert a ⟨*τά*⟩ before it. ⟨*τὰ*⟩ *περί* would be a mere periphrasis as in the *τὰ περὶ τὰς ὀκτὼ φοράς* of 39 b 3. (2) *προχωρήσεις* or *προσχωρήσεις*. *All* the good MSS. have the latter. On the other hand Cicero read the former, since he renders by *antecessiones*. Chalcidius, in his *version*, seems to me, to be trying to hedge (probably knowing both readings); his *accessus* clearly stands for *προσχωρήσεις*, but the preceding reference to *sedes ex quibus progressae sunt* tells the other way, and in his commentary (124, Wrobel, p. 188) he presupposes and explains *progressus* (*προχωρήσεις*). It is not so clear what text Proclus had. Like Chalcidius, he explains that the word is the opposite of *ἐπανακύκλησις* and that this latter means 'retrogradation'. Yet in Diehl's edition of his commentary we find *προσχωρήσεις* in the *lemma* (iii. 145) and both *προσχωρήσεις* and *προσχωρεῖν* in the comment (iii. 146. 11, 12, iii. 150. 1). I suspect that, unless Diehl has himself made a slip, the MSS. of Proclus themselves should be corrected in all three places. At any rate, the explanation given by Proclus is only suitable to a word which means 'advance', 'forward

[1] Did he read *περιττάς* for *περὶ τάς*?

motion', not to one which signifies 'approach'. The remaining questions cannot be *fully* discussed without going into the interpretation of the passage. But we may note that Cicero read τοῖς οὐ δυναμένοις, and that the οὐ was not read by Chalcidius. The negative disappeared from the text then between the time of Cicero and the fourth century A. D. As to δι' ὄψεως or διόψεως, the MSS. testimony cannot be regarded as decisively on the side of the latter, since F's δὲ ὄψεως clearly presupposes a δι' ὄψεως behind it. Cicero translates δι' ὄψεως, since his words are *nullo posito sub oculis simulacro*. The rendering of Chalcidius, *descriptio e uisu atque oculis remota* seems to presuppose the same text. In Proclus Diehl gives διόψεως both in the lemma (iii. 145. 9) and in the two places of the comment where the phrase recurs (ib. 149. 21, 150. 21), but by his own showing the MSS. in the lemma give δι' ὄψεως, and at 149. 21 are divided between διόψεως and δι' ὄψεων. Since the words of Proclus here are λέγει δὲ τούτων τῶν δ. μιμημάτων, ἃ δή ἐστιν ὀργανικά, it seems clear that he means to be explaining δι' ὄψεως or δι' ὄψεων to the effect 'by *these visible imitations*, of course, he means *models*'. Hence I have no doubt that δι' ὄψεως should be read in all these passages. The preponderance of testimony is thus given by the agreement of F with Cicero in favour of δι' ὄψεως. We shall see that it is also intrinsically the better text. The choice between the τούτων αὖ τῶν of APY and the τούτων αὐτῶν of F is more difficult, and can really only be made by consideration of the meaning. Cicero certainly understood the letters ΑΥΤΩΝ as αὐτῶν, since he renders *nullo posito sub oculis simulacro earum rerum*. That is, he construed ἄνευ μιμημάτων τούτων αὐτῶν, 'without a model of these things'. But there is no proof that he grouped the ambiguous letters correctly. Chalcidius paraphrases away. The MSS. of Proclus have αὐτῶν in the lemma, according to Diehl, who writes αὖ τῶν on his own responsibility. This procedure is really not justified, since the αὐτῶν or αὖ τῶν is not represented by anything in the comments of Proclus, and the reading of the MSS. in the lemma is the only indication he gives of the text before him. Had Diehl known of the readings of F in the *Timaeus* he would presumably have altered neither δι' ὄψεως nor αὐτῶν

Next as to the grammatical structure of the sentence. The accusatives χορείας, παραβολάς, τάς (or τὰ περὶ τὰς) ἐπανακυκλήσεις καὶ προχωρήσεις depend on τὸ λέγειν. It would be 'labour thrown away' to speak of these 'appearances' without visible illustration by some kind of model of the system. Unless the text is to be disturbed by unwarranted 'emendation', the rest from ἔν τε ταῖς συνάψεσιν to πέμπουσιν will then be a dependent double interrogative sentence, still dependent on τὸ λέγειν, as is held by both A.-H. and C. W. It is labour thrown away to say, without the help of a model, 'which of these gods getting into conjunction—and diametrical opposition—and behind which, on each occasion are hidden and then reappearing create alarms, &c.' The words, relieved of incidental complications would run (μάταιος ἂν εἴη πόνος λέγειν) ὁποῖοι τῶν θεῶν ἐν ταῖς συνάψεσι κατ' ἀλλήλους γιγνόμενοι κατακαλύπτονται καὶ πάλιν ἀναφαίνονται, 'which of the gods, when they come into conjunction are hidden and then reappear'. This simple phrase is then complicated as follows. Instead of saying καὶ πάλιν ἀναφαίνονται Timaeus, partly for a special

purpose, partly to vary the expression, substitutes *καὶ πάλιν ἀναφαινόμενοι φόβους καὶ σημεῖα πέμπουσιν*. Then, with the usual Greek love for fullness of expression, he adds to *ὁποῖοι κατ' ἀλλήλους γιγνόμενοι* the words *μεθ' οὑστινάς τε ἐπίπροσθεν ἀλλήλοις*, 'and behind which occulting one another', so that the process is described from the point of view of both the bodies which come into conjunction. (To make the structure of the sentence clearer, I would insert a comma in c 8 between *ἀλλήλους* and *ἡμῖν*.) Then he remembers while he is wording this clause thus that the 'gods' not only come into 'conjunction' and 'occult' one another, but are also from time to time in diametrical opposition (180° from each other in the Zodiac), and that 'opposition' as well as 'conjunction' is thought significant by the superstitious. Hence he inserts the words *καὶ ὅσοι καταντικρύ* (*sc. γενομένοι*), though these are strictly parenthetical, and the sentence goes on as if they were not there. Of course when two of them are *καταντικρὺ ἀλλήλοις* there is no 'occulting', no disappearance and reappearance of either, so that unless we understand that the words *καὶ ὅσοι καταντικρύ* exercise no influence on the meaning of what follows, the sentence will appear quite incoherent. The *τε* after *ἡμῖν*, as Stallbaum and others note, does not answer to the preceding *τε*, but goes, by 'hyperbaton', with the *καί* before *πάλιν*, and *ἡμῖν* is an 'ethic' dative with *κατακαλύπτονται* and *ἀναφαινόμενοι* 'are hidden from our gaze and on their return to it . . .' See the excellent note on the passage by Stallbaum, who, however, proposes a needless 'correction' for a sound text. We may now go on to consider the more important words and phrases in detail.

40 c 3–5. As for the terms used here, *χορείας* seems to stand generally for the intricate evolutions of the planets, their 'mazy dance'. *παραβολάς*, 'juxtapositions', 'rangings alongside', is said both by Chalcidius and Proclus to refer to cases like that of the Sun, Venus, and Mercury, where one body remains so near another that it may be said to belong to its 'retinue' (*comitatus*, Chalc.). Proclus says, more precisely, that what is meant is *κατὰ μῆκος συντάξεις*, 'juxtaposition in longitude', *τὰς συνανατολὰς λέγω καὶ συγκαταδύσεις*, 'i.e. the rising and setting together' of planets. *ἐπανακύκλησις*, 'circling round in the reverse direction', is taken by both to refer to a retrograde motion of one planet with respect to another, and this is no doubt correct, since the verb *ἐπανακυκλεῖσθαι* is used in this sense of Mars at *Rep.* 617 b 2 *τρίτον δὲ φορᾷ ἰέναι . . . ἐπανακυκλούμενον τὸν τέταρτον* (*μάλιστα τῶν ἄλλων* add. Theo.). *προχωρήσεις* are then said to be the opposite to this, the movement called *προποδισμός*, 'advance'. This was clearly the established exegesis, and we may be content to accept it.

40 c 6. *ἔν τε ταῖς συνάψεσιν.* Planets were said to be in 'conjunction' when both are in the same sign of the Zodiac. The case Timaeus is specially considering is when the two approach still more closely until they are *κατ' ἀλλήλους* (in one and the same direct line of vision). One then 'occults' the other. When the planets are *καταντικρὺ ἀλλήλοις* this should not be called a *σύναψις* at all. They are then 'disjoined' as fat as possible, but the desire of Timaeus to get in a reference to 'opposition' has destroyed the formal logic of his sentence.

40 d 1. *τοῖς οὐ δυναμένοις λογίζεσθαι.* The 'occultations', 'reap-

pearances', 'oppositions' of the planets cause fear to and are thought portentous by 'those who cannot do a sum'. Those who can 'do sums', astronomers like Timaeus himself, foresee that these appearances will arrive in a natural way from the differences of period of the planets, and are not 'scared', nor do they take the appearances to portend anything. Timaeus has the complete disregard for astrology (its existence among Oriental peoples was of course known to him), which marks all the Greek astronomy of the best period. If the sarcasm here is not meant simply for the uneducated, who are superstitious about portents in the sky without having any *systematic* astrological beliefs, if it refers to 'astrologers', it must be aimed at Orientals like the Babylonians and Persians. The disappearance of the *οὐ* from the text before the time of Chalcidius is explained by the rapid spread of astrology in the later years of the Roman Republic and the early days of the Empire. When the beliefs had taken firm ground, the *diorthotes* of a manuscript of the *Timaeus* would be almost sure, in good faith, to assume that the *οὐ* here could not represent Plato's meaning; he *must* have meant to say that it is just those who *can* compute the behaviour of the heavenly bodies who are alarmed by 'signs in the heaven above'.[1] That the negative is *οὐ*, not *μή*, means that *οὐ δυναμένοις* is treated as equivalent to *ἀδυνατοῦσι*.

40 d 2. δι' ὄψεως. We have seen that this must have been the text read by Cicero. It is a further reason for keeping it—and a good illustration of the importance of F, the one MS. which retains a trace of it—that there is no known word *δίοψις* with a meaning suitable to the passage. If the word was genuine here, it must mean something like a visible 'model', an orrery or the like, which reproduces the movements of the planetary system. But *δίοψις* seems not to be known in this sense, and would be, at least, an oddly formed word. It should mean something quite different, a 'view through' or a 'compendious view', or something of that kind. The actual word seems to occur only three times, all in Plutarch,[2] and in all cases in the sense of a 'clear and unimpeded view through something'. Thus there is no evidence that *δίοψις* could mean what it is supposed to mean by those who read it in this passage.

As to *τούτων αὐτῶν* or *τούτων αὖ τῶν*, neither the MSS. nor the ancient translations can be regarded as decisive where the question is simply one of the division of the letters. Cicero certainly took *αὐτῶν* as one word, but as no division would be marked in a MSS. of his time, he did so on his own responsibility, and he need not be right. We must be guided by

[1] Proclus (Diehl) iii. 151 mentions that Theophrastus in his work *Περὶ σημείων* spoke of the judicial astrology of the 'Chaldaeans' of his own time as very 'wonderful' because it professed to foretell from the planets not merely meteorological phenomena like good and bad weather, but 'the lives and deaths of individuals' (*τοὺς βίους ἑκάστων καὶ τοὺς θανάτους*). This implies that Theophrastus knew of nothing of the kind in the Hellenic world in his own days.

[2] Plutarch *de Pythiae Oraculis* 408 e *καὶ τὰ τοιαῦτα μὲν ἀποφθέγματα τῶν σοφῶν ταὐτὸ τοῖς εἰς στενὸν συνθλιβεῖσι πέπονθε ῥεύμασιν· οὐ γὰρ ἔχει τοῦ νοῦ δίοψιν*, i.e. 'their sense is not transparent' or 'perspicuous'; *Aetia Physica* 915 a *ἐπεὶ δέ φασι καὶ τοὺς κατακολυμβῶντας ὅταν ἔλαιον εἰς τὸ στόμα λαβόντας ἐκφυσήσωσιν, ἐν τῷ βύθῳ φέγγος ἴσχειν καὶ δίοψιν*, they say that when divers spit out olive oil which they have taken into their mouths, they find the waters illuminated and transparent; *Comp. Dem. et Cic.* 1. in a metaphorical sense: *ἔστι δέ τις καὶ τοῦ ἤθους ἐν τοῖς λόγοις ἑκατέρου δίοψις.*

a consideration of the resulting sense. If we read αὐτῶν we must, I think, construe as I take Cicero to have done. That is τούτων αὐτῶν must be an objective genitive depending on μιμημάτων, and the sense will be 'without visible models of these actual things themselves', the point of the expression being that to take in the planetary movements in their full complexity we need to see a *reproduction* (μίμημα) which is not the 'thing itself', but a reduced model from it. The position of δι' ὄψεως will then be a case of 'hyperbaton', but not a harder one than others which we meet in the *Timaeus*. (A.-H. gets the same sense by reading αὐτῶν and inserting a needless ⟨τῶν⟩ before δι' ὄψεως.) If we read αὖ τῶν in two words, τούτων will agree with μιμημάτων. The point of αὖ (in turn) will be that the visible heavenly bodies themselves, like everything else visible, are μιμήματα of the demiurge's archetype, and the 'working model' is a μίμημα of μιμήματα. The τούτων will then have a familiar and slightly depreciatory effect, '*our* poor imitations of imitations'. The 'orrery' which serves as a working model of the heavens will be thus—as the product of a human designer should be—to the actual planets what the painter's picture of a bed in the *Republic* is to the 'bed made by the carpenter'. On the whole this reading and interpretation seem to me to have rather more point than the other, but I am not satisfied that the other may not after all be what Plato intended.[1]

40 d 6—41 a 3. Περὶ δὲ τῶν ἄλλων . . . ἐκγόνους. There are also, we are told, certain *invisible* superhuman beings. No one has ever seen them, and we only know of their existence and genealogies from persons who profess to be their descendants. These persons offer no strict proof, and even no plausible arguments for their assertions. But we may fairly presume that a wise child knows his own father, and we will therefore conform to usage by accepting what these persons tell us about their family histories. By *their* account, Earth and Heaven were the parents of Oceanus and Tethys, they of Cronus and his brothers and sisters, and Cronus and Rhea of the principal Olympians.

This passage is purely, though politely, ironical. Note the emphasis laid on the statement that, not to speak of conclusive proofs (ἀναγκαῖαι ἀποδείξεις), the persons who supply the information have not even εἰκότες λόγοι for their statements, the sarcastic use made of the obviously false assumption that a man *must* know who his father was, the reminder that if we let the stories go unchallenged it is only out of a good citizen's respect for 'usage' (ἑπομένους τῷ νόμῳ πιστευτέον), and, on the top of all this, the emphasis laid a second time on the point that the genealogy given is only what some one else has said (κατ' ἐκείνους, e 3). For the low esteem in which a Pythagorean man would hold mere εἰκότες λόγοι, as distinguished from demonstration, compare what Simmias says at *Phaedo* 92 d about such appeals to 'the probabilities of the case', and the descendants of gods, we are told, have not even this inferior kind of 'moral evidence' to allege. The distinction between such loose appeals to analogy and demonstrations founded, as Simmias puts it (*Phaedo* 92 d 6),

[1] In particular the similarity of τούτων αὐτῶν if read here with the use of the same words at 40 c 4 above makes me very doubtful whether αὐτῶν may not, after all, be another case where F is right against APY.

on an ὑπόθεσις ἀξία ἀποδέξασθαι, an initial postulate which both parties to an inquiry recognize as sound, would thus seem to be familiar to the Pythagorean mathematicians, who naturally have a high standard of 'proof'. The remarks about deference to the established νόμος are not really necessary to protect either Timaeus or Plato from a prosecution for 'impiety'. It was no part of 'popular' religion in a πόλις of the fifth century to believe the tales told by poets about the gods. A man was free to think what he liked about these tales, so long as he showed decent outward respect for the public *cultus*. If it had been impiety to attack poetical mythology, Socrates would have stood in far more need of one than Timaeus for what he says about these matters in *Republic* ii. And it is very important to observe that it is not 'popular mythology', and still less official *cultus*, on which Timaeus is commenting. The leading figures whom he specifies, Gaia, Uranus, Tethys, Cronus, Phorcys, were not the beings worshipped in the Greek πόλεις. Most of them received no cultus whatever. The 'Olympians' mentioned, Zeus and Hera, are not those who should have been specified first and foremost by any one intending to level his irony at Athenian public worship, Athena and Hephaestus, the 'two goddesses', and Apollo Patrous. The satire is directed against speculative theogonies like those of Hesiod and the Orphics. The point that Earth and Heaven are the primary pair of deities shows that Timaeus is thinking more of Orphicism than of anything else. We still read on the gold plates buried in Crete and Italy in the tombs of Orphics the lines of their scriptures in which the dead man's ψυχή claims to be a god on the ground that, like the other gods, it is a child of 'Ge and starry Uranus'. (Hesiod's arrangement is rather different. With him Uranus is not a primitive figure, but comes in in the second 'generation', being the son as well as the spouse of Gaia.) The sarcasm about the wise child who must know his own father has the same reference. Many eminent men, e. g. the Spartan kings, Alcibiades, Socrates himself, had legendary pedigrees which went back to Zeus,[1] but this is not what is meant. It is not the Heraclidae nor the Philaidae nor the Daedalidae who are supposed to be the *authorities* for the existence of invisible δαίμονες. No one believed in Zeus on the ground that he figured in the family-tree of Socrates. The point is that *theogonies* were fathered on legendary authors who were fabled to be of supernatural birth, like Orpheus, Eumolpus or Musaeus. (Cf. the similar sarcasm in *Rep.* ii. 365 e.) Timaeus would have all the more reason to dissociate himself from these persons that there was so much in the religious side of early Pythagoreanism which was closely akin to Orphic fancies and superstitions. He is a member of a 'Church' which has gone in for 'science' and 'liberal theology', and he has no wish to be made responsible for the beliefs of those followers of Pythagoras who have lagged behind the march of

[1] *Alcibiades* i. 120 e 8 ἢ οὐκ ἴσμεν ὡς οἱ μὲν (the Spartan kings) Ἡρακλέους, οἱ δὲ (the kings of Persia) Ἀχαιμένους ἔκγονοι, τὸ δ' Ἡρακλέους τε γένος καὶ τὸ Ἀχαιμένους εἰς Περσέα τὸν Διὸς ἀναφέρεται;—καὶ γὰρ τὸ ἡμέτερον, ὦ Σώκρατες, εἰς Εὐρυσάκη, τὸ δ' Εὐρυσάκους εἰς Δία.—καὶ γὰρ τὸ ἡμέτερον, ὦ γενναῖε Ἀλκιβιάδη, εἰς Δαίδαλον, ὁ δὲ Δαίδαλος εἰς Ἥφαιστον τὸν Διός. (See the scholium on this passage which gives the line of descent.) And for the ironical tone, cf. also *Epinomis* 985 c. There, as here, the object is to exalt the 'host of heaven' at the expense of these creations of man's fancy.

'development'. That Oceanus and Tethys are children of Gaia and Uranus we read in Hesiod.[1] Phorcys—a marine creature—is said in the *Theogony*[2] to be sprung from Earth and Sea. This crowd of figures from the theogonies is not mentioned again. We must not suppose that they are the beings to whom the ensuing speech of the Creator is addressed. It is really the '*visible* deities', the host of heaven, and apparently more particularly the seven 'planets' who are associated with the supreme God in the making of man.

40 e 4. ἡ γένεσις = 'pedigree'. For examples of this sense see Herodot. ii. 146 *ἀπ' οὗ δὲ ἐπύθοντο χρόνου, ἀπὸ τούτου γενεηλογέουσι αὐτῶν τὴν γένεσιν*, Sophoc. *Trach.* 380 *πατρὸς μὲν οὖσα γένεσιν Εὐρύτου*, Evang. Matth. i. 1 *βίβλος γενέσεως* (the 'family-tree') *Ἰησοῦ Χριστοῦ υἱοῦ Δαυεὶδ υἱοῦ Ἀβραάμ*.

40 e 6–7. ὅσοι μετὰ τούτων, *sc.* the 'Titans'. Hesiod (*Theog.* 134) mentions Coeus, Crius, Hyperion, Iapetus, Thea, Themis, Mnemosyne, Phoebe. But his account makes the Titans children of Ge and Uranus, and therefore brothers and sisters of Oceanus. According to *Cratylus* 402 b–c, the descent of the 'gods' from Oceanus and Tethys is 'Orphic'. Socrates professes playfully to find it also in Homer's line (Ξ 201) *Ὠκεανόν τε, θεῶν γένεσιν, καὶ μητέρα Τηθύν*. At *Philebus* 66 c Plato quotes as 'Orpheus' the line *ἕκτῃ δ' ἐν γενεᾷ καταπαύσατε κόσμον ἀοιδῆς*. This fits in with Timaeus, since, if we reckon Ge herself as the first *γενεά*, we get altogether exactly six, (1) Ge, (2) Ge and Uranus, (3) Ocean and Tethys, (4) Cronus and Rhea, (5) Zeus and Hera, (6) the younger 'Olympians'.

41 a 3–6. ἐπεὶ δ' οὖν . . . τάδε. The Creator now calls the created 'gods' together, addresses them on their station and its privileges, and calls on them to take a subordinate part in the creation of mortal living beings.

δ' οὖν has its usual force of leaving undecided an irrelevant side issue and returning to the main topics 'however that is', i. e. whether we take the Orphics seriously or not. The 'gods' who *περιπολοῦσιν φανερῶς* are those which every one can see, the heavenly bodies; those who only show themselves when it is their good pleasure to do so are the personages of the theogonies. Timaeus means to hint that no sight of them has ever been vouchsafed to him. For the view that a 'god' is only recognizable when he pleases, but mostly passes incognito, cf. the Homeric parallels E 127, 844, 863 and the like. As this belief in gods who go about unseen or in disguise is attacked along with the beliefs in absolutions to be got by 'initiations' in *Rep.* ii, presumably it also formed part of the Orphic's stock-in-trade. Cf. the language of *Epinomis* 985 d.

41 a 7–d 3. θεοὶ . . . πάλιν δέχεσθε. The drift of the Creator's speech is that though the newly fashioned 'gods' are not *de iure* immortal, because 'whatever has been put together can be taken apart again', still they can only be 'taken to pieces' by the same power which 'put them together', the Creator's will, and He wills their continuance;

[1] *Theogony* 132–6 *αὐτὰρ ἔπειτα | Οὐρανῷ εὐνηθεῖσα τέκ' Ὠκεανὸν βαθυδίνην | . . . Φοίβην τε χρυσοστέφανον Τηθύν τ' ἐρατεινήν.*

[2] ib. 237, where it is said (of *Πόντος*) *αὖτις δ' αὖ θαύμαντα μέγαν καὶ ἀγήνορα Φόρκυν | Γαίῃ μισγόμενος.*

hence *de facto* they are immortal and imperishable, like everything which comes from His hands. He will not Himself directly fashion the 'mortal' creatures who are now to be created to complete the universe, but only that element in these creatures which is destined to be immortal. The created deities, as intermediaries, are then to finish the work by giving this immortal element its mortal complement.[1]

41 a 7–8. Θεοὶ . . . ἐθέλοντος. The construction of this sentence depends on the reading adopted. Unfortunately the words have suffered from more than one very ancient corruption. (1) *θεοὶ θεῶν* certainly was read by Cicero, who renders *vos qui deorum satu orti estis*. But the words must be corrupt. They yield either no meaning or one which is quite out of place. The only thing *θεοὶ θεῶν* can mean in classical Greek would be 'gods who are the *θεοί* of other gods', 'gods who have gods for their worshippers', precisely as *βασιλεὺς βασιλέων* means a king whose subjects are themselves *βασιλῆς*, a king over kings. It is in this sense that Zeus is called on p. 121 of the *Critias* *θεὸς ὁ θεῶν Ζεύς*, he is the being whom the other *θεοί* adore. This is also the meaning of 'god of gods', 'lord of lords' in our own Scriptures. The deity of Israel is worshipped as God by the beings who are the 'gods' of other nations. But this meaning is here quite inappropriate. The only being in the dialogue who could be called a *θεὸς θεῶν* in this sense is the Creator Himself; it is ridiculous to make Him bestow such an appellation on his own creatures. Cicero supposed that the words mean 'gods sprung from gods', and he has sometimes found defenders. But (*a*) such a phrase is linguistically impossible, because there is nothing in the words to indicate that the genitive is one of origin. You can say *υἱὸς πατρός* or *παῖς πατρός* because the nature of the relation between a *υἱός* and a *πατήρ* is obvious as soon as the words are uttered, but you can no more say *θεοὶ θεῶν*, meaning 'gods sprung from gods', without supplying *ἔκγονοι* or some equivalent, than you can say *ἄνδρες γυναικῶν*, meaning 'men born of women'; *ἀνὴρ γυναικός* by itself could only mean one thing, 'husband of a wife', and *θεὸς θεῶν* can only mean one thing 'god worshipped by gods'. (*b*) The meaning is unsuitable to the passage. The beings who are being called on to aid in the making of men are, as we shall see more fully directly, the earth and the planets. There is no reference to the successive dynasties of gods of the theogonies, whose very existence Timaeus has just politely denied. Now the earth and the planets might conceivably be said to be 'sprung from *a* god', since we have been told that they were made by the Demiurge. But they could not be called 'offspring of *gods*'. They themselves are the only 'gods' recognized in our dialogue.

It has been suggested by those who see that neither of the renderings just examined is possible, that *θεοὶ θεῶν* may be an 'intensive' expression like the poetical and semi-poetical phrases *κακὰ κακῶν*, *ἄρρητ' ἀρρήτων*.

[1] For the thought that only those works of the Creator are 'corruptible' which are produced indirectly through 'second causes', and in fact through the influences of the celestial 'spheres', cf. Dante *Paradiso* xiii. 52–84, especially 61 ff. 'Quindi discende a l' ultime potenze | giù d' atto in atto, tanto divenendo, | che più non fa che brevi contingenze'; 76–8 'Ma la natura la dà sempre scema, | similemente operando a l' artista, | c' ha l' abito dell' arte e man che trema'.

(So Apelt, A.-H.) Fraccaroli rightly objects that these phrases are poetical and that the use is only found with *adjectives*. He should have remarked that the reason is that the genitives in these cases are *partitive*, and are thus exactly parallel with the usual genitive after a superlative; κακὰ κακῶν means literally a state of things which stands out as κακόν in a superlative degree from a background of κακά, a state which is κακόν by comparison not merely with happiness, but with ordinary misery itself. But in such a phrase as θεοὶ θεῶν there is nothing to show that the genitive is partitive; in fact, idiom would suggest that it is 'objective'. And again, the sense is not appropriate. The beings addressed are not gods in any 'intensive' sense; they are not more but less divine than the only things with which they could be conceivably contrasted, the Creator, the αὐτόζωον, the οὐρανός as a whole. I feel little doubt that Badham was right in his view that θεῶν is an ancient corruption of ὅσων, so that the original words were θεοὶ ὅσων ἐγὼ δημιουργός κτλ.

(2) The next point of difficulty arises in connexion with the ἃ after ἔργων. Here, again, it seems clear that F, which omits the word, has preserved the true text against the consensus of APY. The *earliest* testimonies in later writers appear also from Bt.'s note to omit ἃ. The obvious objection to it is that, unless we delete it, we have not a complete sentence at all, but a mere vocative expression. There arises also a grave difficulty about the question whether the words ὧν ἐγὼ δημιουργὸς πατήρ τε ἔργων refer exclusively to the 'created gods' (are they the ἔργα in question?) or generally to *whatever* is made immediately by the Creator. And again, if the reference is the narrower one, how is ὧν to be construed? In fact is the meaning 'gods, of whom I am father and creator of things which . . .' (whether the 'things' means only the 'gods' or is universal), or is it 'gods of whose works I am father and maker, which works . . .'[1]. A reading which, besides failing to give a complete sentence, entangles us in such intolerable ambiguities is decidedly to be rejected. If we omit the ἃ with F and many early testimonies, all difficulty vanishes. ὧν ἔργων is then a case of 'inverse relative attraction' for ἔργα ὧν, or rather the true explanation is that, as in other cases of this so-called 'attraction', we have a condensation of the full expression ἔργα ὧν ἔργων. The sentence now becomes a straightforward statement 'works whereof I am maker and father, inasmuch as they are *my* handiwork, are indissoluble . . .' The reference is not specially to the ἔργα addressed, the created gods, but is *general* and is meant to explain *two* points (*a*) the *de facto* immortality of these gods, (*b*) the Creator's reason for giving them a share in the making of man. I cannot doubt that this—the text of F—is what Plato wrote. This is also the text read by Cicero, who renders, according to the critical edition of Baiter and Halm, 'quorum operum ego parens effectorque sum, *haec* sunt indissolubilia me invito'. This is the form in which the sentence appears also in Augustine *de civitate Dei* iii. 16, where it is

[1] There is the third alternative, which is in fact the correct one, except for the retention of the ἃ which has caused all the trouble, of taking ἔργων and ὧν together. With the ἃ this gives the sense 'ye gods, ye works whose father and maker am I'. This is Martin's method, and is apparently that of Chalcidius too, as he writes 'di deorum, quorum opifex idemque pater ego, *opera siquidem uos mea*'.

expressly given as from the *Timaeus* of Cicero. The *quae per me facta* inserted before *haec* in Orelli's and some other editions appears to rest on no MS. authority, and was rightly expelled long ago by Lambinus.[1] Thus the grammatical fault introduced by the intrusion of ἃ into the text is that what ought to be an enunciation is converted into an exclamation; the logical fault is that, translating in the least forced of the possible ways, that of Chalcidius and Martin, we have to convert what is meant as a statement of a general principle, 'works made by Me are indestructible' into a specific assertion about one particular set of these 'works'. The major premiss of a 'syllogism in *Barbara*' is thus mistaken for the conclusion, and the next sentence becomes superfluous.

As to the origin of the error in A and its congeners, I would suggest that originally some one who saw the meaning, but was offended by the 'inverse attraction' of ἔργων and wished to 'correct' what he took for a scribe's error, wrote the letter A above the line as an 'emendation', thus

A
ΕΡΓΩΝ. The A had then only to be taken as an *omitted* letter restored by a *diorthotes* to give the 'vulgate' text.

For δημιουργὸς πατήρ τε cf. ποιητὴν καὶ πατέρα τοῦδε τοῦ παντός, 28 c 3 *supra*. There is the less difficulty about the combination because in Greek you can say ποιεῖν υἱόν, 'to beget a son', as you also say in Latin *creare filios*, and παιδοποιία is the standing word for human 'procreation'. *Both* words refer to the ψυχαί as well as to the σώματα of the θεοί.

(3) ἐμοῦ γε μὴ ἐθέλοντος. The μή stood in the text rendered by Cicero, but was absent from that known to Chalcidius, who writes *me ita uolente*. As for extant MSS., A has it, though the *diorthotes* has marked it for deletion, F has not. The sense is better if we retain it, for (*a*) the verb which has to be supplied should be that directly suggested by ἄλυτα, viz. λύειν not μὴ λύειν, 'indissoluble so long as *I* refuse to undo my work'. If we omit the μή with ἐθέλοντος, we must, I think, understand it with the 'supplied' infinitive, and this is not in keeping with the idiomatic use in

[1] The modern editors have great trouble with the corrupted text. Stallbaum makes a gallant attempt to deal with it. He renders 'ye gods, whose works have me for father and author', thus making ὧν mean ὧν θεῶν, and depend as a genitive of origin on ἔργων. He *explains* that the stars or planets which the ψυχαί of the 'created gods' control may be said to be the ἔργα of those gods. But surely they are themselves direct ἔργα of the Creator? He quite omits to notice the absence of any 'principal enunciation' from the words construed in this fashion. Martin does rather better so far as sense is concerned, rendering, like Chalcidius, 'ye gods, works whose father and maker I am, being produced by me, you are indestructible'. It is not clear how he construes. He takes ἔργων in apposition to θεῶν, and correctly makes ἔργων, not θεῶν, antecedent to ὧν. But he translates as though the ἃ printed in his text were not there, and further has to supply a verb of the second person plural (ἐστέ) with ἄλυτα to make a sentence. A.-H. wishes to take ἔργων as dependent on πατήρ only, and not on δημιουργός, so as to get the sense 'gods of whom I am creator and father of works which, by me coming into being, are indestructible, &c.' This seems hopeless: πατὴρ ἔργων would surely be almost unexampled Greek. It is only because the δημιουργός τε is added to πατήρ that ἔργων can be connected with it. ἔργα normally have a δημιουργός, but not a πατήρ. Apelt proposes, after Bernays, to omit the whole clause [ἃ] . . . γενόμενα. Fraccaroli, like A.-H., misconstrues ὧν, and does not see the difficulty about [ἃ]. Rivaud omits the intrusive ἃ, but gives the *impossible* rendering 'dont je suis l'Auteur et des œuvres desquels je suis le Père'.

such phrases. (*b*) And if we could 'understand' μὴ λύειν, we still should not get quite the sense required. ἐμοῦ γ' ἐθέλοντος (μὴ λύειν) ought to mean 'at least, *not with my consent*'. Thus the notion would be implied that the 'created' gods might conceivably be destroyed βίᾳ 'against the Creator's wishes', and nothing is further than this from the speaker's mind. Martin, indeed, attempts to omit the μή and yet avoid the difficulty, by translating '*because* I will it', viz. 'that my works shall not be destroyed', 'that they shall be ἄλυτα'. This is not permissible as a 'construe', since (*a*) the force of the γε must be *restrictive* 'on the understanding that', and (*b*) ἐθέλειν is not to 'will' but to 'consent', 'to give one's consent'. That to which the Creator 'refuses His consent' is the undoing of His work.[1]

41 a 8–b 6. τὸ μὲν οὖν δὴ δεθὲν . . . συνεδεῖσθε. This might mean either of two things. The δεθέν, &c., might refer to the putting together of the ψυχαί themselves out of the ingredients described at 35 a, or to the union of the ψυχαί with their bodies. The principle that what the supreme God has put together cannot be put asunder by anything other than His will would cover both cases, and Timaeus clearly has both in mind. He means that the ψυχαί of the 'created gods' will never be destroyed, and also that they will never be divorced from their bodies, but, as we see from the rest of the speech, it is the second thought which is most prominent. The great difference between the ἀθάνατα and θνητὰ ζῷα is that the former never experience the χωρισμός of soul from body. Hence our passage is not *exactly* parallel to *Rep.* x. 611 b 5, where the ψυχή in *us* is said to be σύνθετον ἐκ πολλῶν καὶ μὴ τῇ καλλίστῃ κεχρημένον συνθέσει. The reference there is to the union in the human ψυχή of the elements λογιστικόν, θυμοειδές, ἐπιθυμητικόν. The ψυχαί of the 'created gods' do not contain the factors θυμοειδές, ἐπιθυμητικόν at all. They are made later for the *human* soul, to adapt it for its temporary union with a *mortal* body (69 c ff.). Timaeus speaks here at first as if the task of the 'created gods' were merely to make θνητὰ σώματα for immortal ψυχαί, but, as he goes on, he quietly corrects this first impression, and we find that the human ψυχή itself has to receive temporary modifications to adapt it to its sojourn in the body. In 41 b Timaeus does not teach without qualification the doctrine of the 'natural immortality' of the soul. Whatever 'comes into being' may conceivably have an end. In the last resort, the reason why the 'created gods' will never perish, is not that they are 'naturally' indestructible but that the goodness of God ensures their continuance. To put his point without the imaginative fiction of a 'making' of the soul 'in time', he means that nothing which is, in its nature, derivative and dependent is inherently everlasting. But the good souls which preside over the 'orderly motions' of the heavens will in fact never perish, because it is 'best' that they should persist. Like Leibniz, he represents the principle that things are ordered as it is best they

[1] Augustine (*de civit. Dei* xxii. 26) might seem at first sight to be in favour of omitting the μή, as he makes Plato's Creator say 'vos quidem immortales esse non potestis, sed mea voluntate immortales eritis'. But this is rather a paraphrase than a translation, and the evidence of Augustine and Chalcidius together is less valuable in a textual matter than that of Cicero alone.

should be ordered by a divine 'choice of the best'. Hence he says that the Creator's will is an even more 'durable bond' than the law of proportion in accord with which the *ψυχαί* were constructed. This law itself was a consequence of God's goodness. He constructed the *ψυχαί* in accord with it, because he wanted to make His work good. What T. appears to mean in the present passage is that the reason why the souls never perish is not so much that they have once for all been made of a certain kind, as that the will of God which was expressed by making them such also shows itself in their conservation. As Descartes put it in the *Third Meditation*, preservation is equivalent to continual new creation. Or, to take another modern illustration, Timaeus would agree with Lotze that every soul or other constituent of the universe persists so long as its persistence is demanded by the 'scheme of the whole', but, unlike Lotze, he would add that, since goodness is the foundation of the whole scheme, it demands the everlasting persistence of a constituent so precious as the soul. This is his way of asserting 'the conservation of values', and like any formulation of that principle which is of any worth, it goes beyond what can be established by science and involves 'religious' trust. The whole thought is a development of the doctrine of the *Phaedo* that the reason for any arrangement in the universe is that 'it is best that it should be so'. The link (*δεσμός*) between what is and what is best is supplied by the existence of a supreme *ψυχή* which steadily *wills* the best.

Note also that we now see why it is that the Creator makes the *bodies* of the *οὐρανός* and its stars and planets Himself, but leaves the 'created gods' to make *our* bodies. The point is that Timaeus regards the heavenly bodies as indestructible. For them there is no dissolution either of *ψυχή* from *σῶμα* or of *σῶμα* into its own constituents. Our bodies return after a few years to the general mass of earth, water, &c., out of which they are made. It is important that there is no trace here of the heresy of the inherent 'badness' of matter which infected the popular Platonism of later ages. The reason why *our* bodies are represented as made by intermediate agents is not that 'matter' is too impure to be brought into direct relation with God, but simply that *our* bodies are not indestructible.

41 b 3. οὔτι μὲν δὴ λυθήσεσθε κτλ. The *words* do not absolutely exclude the possibility that the 'created gods' might come within an 'ace' of destruction and be saved at the critical moment by a divine interposition, as in the *Politicus* myth God periodically rescues the world-ship just as the waves are closing over it. But a corruption of this kind is entirely at variance with the whole spirit of the Creator's address.

41 b 6–d 3. νῦν οὖν ὃ λέγω . . . δέχεσθε. The 'created gods' are now called on to take part in the creation of mortal living creatures. These are to be composed of an immortal and a mortal part. If they were fashioned directly and wholly by the Demiurge, they would be 'equal with gods' (*θεοῖς ἰσάζοιτ' ἄν*), that is, they would be wholly immortal, since to the Greek mind the *one* standing distinction between gods and men is that the gods do not die. (Hence it was always understood that to assert the immortality of the soul is the same thing as saying that the soul is a god, a doctrine which has deeply influenced Christianity through

the teaching of 'Dionysius the Areopagite' that the destiny of the soul is *θέωσις*, 'deification'.) Consequently no provision would be made for mutability and the *succession* of generations. (And, it is assumed, it is 'better' that there should be a world in which there are both mortals and immortals than one in which there are only immortals. It 'takes all sorts to make a world' complete.) So the Creator explains that he will provide the immortal part of the creatures yet to be fashioned; the mortal part is to be worked into the texture by the created gods. The plain meaning of this is simple enough. It is the creation of *man* which is to be treated of. Man has an immortal part (his *ψυχή*) and a mortal part (his *σῶμα*). That there is also temporarily a 'mortal' ingredient in his *ψυχή* is a refinement which will only have to be taken into account later. The *ψυχή* comes direct from God, the mortal body is 'earth of the earth'. As it returns to earth, so it comes from earth. It is, in fact, a compound of the four 'roots'. Its substance is thus derived from the planet on which we live, and restored to that planet again when we die. And while we are alive, the body is nourished by taking in material from its surroundings, converting that material into living tissues which are themselves chemical compounds of the 'roots', and excreting the 'refuse'. Unlike the *ψυχή*, the body comes from the substance of the planet, lives on that substance, and is at last restored to it. This, and, *be careful to note*, nothing like the later astrological theories of the planetary influences on the endowments, characters, and destinies of men, so familiar to us from e. g. Chaucer and Dante, is the simple meaning of the Creator's speech. (As we shall see, Timaeus holds that the planets are inhabited; he is thinking of the part they play in keeping up the life of the 'men' who live on them, not of any 'influence' of Venus or Jupiter or Saturn on *our* history.)

41 b 7. θνητὰ ἔτι γένη λοιπὰ τρία, i. e. those which were to inhabit the air (birds), water (fishes, &c.), and dry land respectively (39 e 10). The fourth *γένος* was that of the *θεοί* themselves, and is not *θνητόν*.

41 c 1. δεῖ δὲ . . . εἶναι. Thus the existence of *θνητά* as well as of *ἀθάνατα* is required for the completeness of the *οὐρανός*; death and generation are part of the original good plan of God, not 'consequences of sin'. Timaeus would not have agreed with an Old Testament writer that 'the Almighty made not death . . . but by envy of the devil death entered into the world' (Wisdom i. 13, ii. 24). The underlying thought takes us back to the very beginnings of Greek speculation. A world is made up of 'opposites', *ἐναντία*, like hot–cold, moist–dry, and to be 'complete' it must contain *all* the pairs of 'opposites', and *ἀθάνατοι–θνητοί* are just such a pair. This particular pair are most familiar to us from the prominence given to them in the remains of Heraclitus, whose fundamental thought was just that it is the combination of such 'opposites' which keeps up the 'secret attunement' (*ἀφανὴς ἁρμονίη*) of the system. To quote his own words (Heracl. *Fr.* 62 Diels = 67 Bywater, R. P. 46) *ἀθάνατοι θνητοί, θνητοὶ ἀθάνατοι, ζῶντες τὸν ἐκείνων θάνατον, τὸν δὲ ἐκείνων βίον τεθνεῶτες*, 'mortal immortals, immortal mortals, each living the others' death, dying the others' life'. We must remember that the 'opposites' are specially fundamental in Pythagoreanism. Hence the 'mortal' has to be got into the

system somehow and cannot be got in if the Demiurge directly makes everything Himself. His immediate creatures therefore make it. Though themselves created, they are not mere puppets but free agents who can make something in their turn, only their works are inferior to those of their Creator. So Christian theologians have often explained how God can be all-powerful and all-good and yet the world contain evil by saying that God creates beings with wills of their own, who can *choose* right and, for that very reason, *can* choose wrong.

41 c 6–7. καθ' ὅσον . . . προσήκει. The phrase is a periphrasis for 'in respect of their *ψυχή*', since *ψυχὴ πᾶσα ἀθάνατος*. Or, to be still more precise, the meaning is 'in respect of the fundamental character of their *ψυχή*, since we learn later on that *ψυχή* acquires certain new and non-permanent characters, the *θνητὸν εἶδος ψυχῆς*, in virtue of its conjunction with a perishable body. *ὁμώνυμον* is not, of course, used in the sense which had become technical in the next generation. In that sense, as the opening words of Aristot. *Cat.* (1ª 1) tell us, *ὁμώνυμα λέγεται ὧν ὄνομα μόνον κοινόν, ὁ δὲ κατὰ τοὔνομα λόγος τῆς οὐσίας ἕτερος*, as to take Aristotle's example, *ζῷον*, which may be said of a man or of a lifeless 'sketch' (*ζῷον ὅ τε ἄνθρωπος καὶ τὸ γεγραμμένον*), or to take Spinoza's *canis*, which may be *animal latrans* or the constellation *Canis Maior*. Here the word means what Aristotle calls *συνώνυμον*. (*Cat.* 1ª 6 *συνώνυμα δὲ λέγεται ὧν τό τε ὄνομα κοινὸν καὶ ὁ κατὰ τοὔνομα λόγος τῆς οὐσίας ὁ αὐτός*, as when a man and an ox are both called *ζῷον* in the same sense of the word *ζῷον*.) What is implied is the Orphic doctrine that the *ψυχή* in us is immortal, and therefore, in principle, divine; in fact, is itself a 'god'. So in the verses inscribed on the Orphic sepulchral plates the soul says to the gods of the unseen world, *καὶ γὰρ ἐγὼν ὑμῶν γένος ὄλβιον εὔχομαι εἶναι*, and Empedocles calls himself *θεὸς ἄμβροτος, οὐκέτι θνητός*.

41 c 7. ἡγεμονοῦν. It is from the frequent Socratic and Platonic use of *ἡγεῖσθαι* for the 'direction' and 'control' which wisdom in the soul should have over the behaviour of the whole man that the Stoics got their name for the 'dominant' principle or faculty (in the case of *man* = intelligence), *τὸ ἡγεμονικόν*, and from this, I presume, by a curious debasement, comes the language of Pope and his contemporaries about the '*ruling* passion'. The following words *ἐν αὐτοῖς . . . ἕπεσθαι* are slightly ambiguous. The phrase might mean (*a*) 'that *in* them which exercises control of the (*elements*) which consent to follow you and Right', or (*b*) 'that which exercises control *among* them of those who consent, &c.', the *ἐν αὐτοῖς* meaning not 'in the constituents of their *ψυχαί*' but 'among the *θνητὰ ζῷα*'. Since the preceding *αὐτῶν* refers to the *ζῷα*, I take it that (*b*) is what is intended. *ἐν* will then mean 'among', not 'in', and the *ἐν αὐτοῖς* will really belong to the clause *τῶν . . . ἐθελόντων ἕπεσθαι*, though placed before it by an 'hyperbaton'.

41 c 8. σπείρας καὶ ὑπαρξάμενος, 'having sown the seed and ⟨so⟩ *made a beginning* ⟨of the work⟩' (C. W.) *not* 'having sown and *provided* it' (A.-H.). This would be an unexampled transitive sense of the middle of *ὑπάρχειν*. For parallels see L. & S. s. v. *ὑπάρχω* A. 4.

41 d 1. τὸ δὲ λοιπόν, adverbial, not, of course, agreeing with *θνητόν*, 'thereafter'. In the phrase 'weaving mortality upon immortality', *τὸ*

ἀθάνατον is thought of as the 'warp', which the Creator sets up on the loom; the lesser 'deities' then work in the *softer* and less *durable* threads of the 'weft'. For the implied contrast between the hardness and permanence of the warp and the softness of the weft cf. *Laws* v. 734 e—735 a *καθάπερ οὖν δή τινα συννφὴν ἢ καὶ πλέγμ' ἄλλ' ὁτιοῦν, οὐκ ἐκ τῶν αὐτῶν οἷόν τ' ἐστὶν τήν τε ἐφυφὴν καὶ τὸν στήμονα ἀπεργάζεσθαι, διαφέρειν δ' ἀναγκαῖον τὸ τῶν στημόνων πρὸς ἀρετὴν γένος—ἰσχυρόν τε γὰρ καί τινα βεβαιότητα ἐν τοῖς τρόποις εἰληφός, τὸ δὲ μαλακώτερον καὶ ἐπιεικείᾳ τινὶ δικαίᾳ χρώμενον κτλ.* The same point is made at *Politicus* 309 b.

41 d 2–3. ἀπεργάζεσθε ζῷα . . . δέχεσθε. The first two words show that Timaeus is still thinking of the antithesis immortal part–mortal part as equivalent to that of soul–body, since it is the union of these last two which makes a *ζῷον*. The thought of what follows is simply that our bodies are made of stuff drawn from the earth, air, &c., around us; we are 'nourished' by similar stuff which we take in as food or when we breathe; so long as our bodies can assimilate more and more of it, we grow bigger (*αὐξάνετε*); when the power of assimilation becomes enfeebled, they shrink (*φθίνοντα*) and grow feeble. In the end, when we die, the earth in us goes back to the earth outside, the water to water, the air to air, and so on. The speech is only fully intelligible when we bear in mind that it is really addressed to the earth and the planets, all assumed to be inhabited by 'men'. The gods of the theogonies have nothing to do with the work described. Timaeus no more regards Zeus and his family as 'legal tender' than the Socrates of the *Clouds*. On the other hand, *his* 'created deities', the planets, no more received worship at Locri than they did at Athens.

41 d 4–7. The making of human *ψυχαί*. They are 'mingled' by the Creator in the same 'bowl' as the soul of the *οὐρανός*, but are not blended with the same perfection; they are a 'second' or 'third' vintage (*δεύτερα καὶ τρίτα*). Note that they are blended directly by the hands of the Creator, and they are not made of what was left *in* the *κρατήρ*. The brew made in it was all used up, and the Creator has to 'brew' afresh in the same *κρατήρ*. The *ὑπόλοιπα τῶν πρόσθεν* are not 'remains of the former mixture'; that all went into the *ψυχή* of the *οὐρανός* (36 b 6 *supra τὸ μειχθὲν ἤδη πᾶν κατανήλωκει*). What is meant is 'remains' of *ἀμέριστον, μεριστόν, οὐσία*. Timaeus is no 'pantheist' or 'emanationist'. He regards the souls of individual men as inferior in quality to the soul of the *οὐρανός* or those of the planets and stars, just as the soul of one man may be inferior to the soul of another. But our souls are neither 'parts' of the cosmic soul nor 'emanations' from it. They are just as directly the 'creation' of the Supreme God as the cosmic soul is. The whole point of the making of the 'second brew' is to avoid that very denial of the reality of personal individuality which leads to the intellectual muddle called 'pantheism'.

41 d 8–e 3. συστήσας . . . εἶπεν αὐταῖς. The Creator made as many human souls as there are stars; he then allotted one of these souls to each star and placed it on the star as a 'chariot', and there displayed to it the 'nature of the universe and its laws'.

ἰσαρίθμους τοῖς ἄστροις. The procedure is quite clear if we understand

that the ἄστρα meant are *stars*, not *planets*, and that this procedure is separate from and preliminary to the 'sowing' of the souls in the planets of which we shall hear directly. It is assumed that the number of 'souls' in existence is fixed once for all, and there are as many of them as there are stars. (For the first point cf. *Rep.* x. 611 a 5 where Socrates treats it as obvious that if souls are immortal, ἀεὶ ἂν εἶεν αἱ αὐταί, the *same* souls exist always. No doubt this was the original Pythagorean view, as it follows at once from the position assumed throughout the *Phaedo* that the soul is immortal *a parte ante* as well as *a parte post*.) That the planets are not the ἄστρα in question is clear both from the express statement that God made a one-to-one correspondence between souls and ἄστρα (ἔνειμε θ' ἑκάστην πρὸς ἕκαστον), and from the careful explanation that the subsequent 'sowing' of the souls took place into the 'moon and the other ὄργανα χρόνου' (42 d 5), which are thus sharply distinguished from the ἄστρα. Confusion on this point has worked much havoc with exegesis both ancient and modern. Chalcidius (*Comment.* §§ 140–1, Wrobel, p. 201), interprets the διεῖλεν of d 8 to mean that God 'cut up' the souls on the same principle on which he divided the cosmic soul into a circle of the Same and a circle of the Other and then went on to subdivide the second circle. No doubt this is supposed to be done, but the doing of it has been already indicated by the words μίσγων τρόπον μέν τινα τὸν αὐτόν; it cannot be got out of the words διεῖλεν ψυχὰς ἰσαρίθμους τοῖς ἄστροις, in which ψυχάς can only be an 'inner' accusative, 'divided it into souls'. It looks as though Chalcidius had been led astray by a confused notion that the ἄστρα here mean the planets in the circle of the Other, though in commenting on the very next clause he correctly says that each soul is sent to a different star (*super inposuit stellis singulis singulas animas*). The explicit confusion of the ἄστρα with the planets is made by Proclus, and compels him to raise the question how Plato can say that the number of the planets, which is only seven, is the same as that of human souls. He has to get out of the *impasse* by the impossible contention that ἰσαρίθμους is not to be taken to mean what it says, but explained away symbolically. Martin made a still worse blunder, in which he has been followed by A.-H. Taking the ἄστρα to mean the planets, he supposed that what God does is to make seven great slabs, so to put it, of soul-stuff, not yet divided into individual souls. It need hardly be pointed out that the whole discourse of the Demiurge on p. 42 is meaningless unless he is supposed to be addressing the actual persons who are to be the first generation of men (cf. γένεσις πρώτη μὲν ἔσοιτο τεταγμένη μία πᾶσιν, 41 e 3; ὁ μὲν εὖ τὸν προσήκοντα χρόνον βιούς, 42 b 3, &c.). A.-H. sees and says correctly that the ἄστρα meant are the stars, not the planets; thus he does away with the misunderstanding that led Martin to his singular interpretation. Yet he oddly enough retains this explanation, saying that the ψυχαί distributed to the stars are masses of 'undifferentiated soul-substance'. Plato never anywhere in his writings says anything about 'soul-substance' at all. A ψυχή with him means not a 'substance', but a 'movement which moves itself', and every such movement is strictly individual. What M. and A.-H. means by 'substance' is, in fact, the Aristotelian ὕλη, a 'stuff' which is the 'substrate'

of individual things, and is then often supposed (though *not* by Aristotle) to be 'more real' than the individual things. But this notion of 'substrate' is not to be found in Plato, and can only be read into his works by an 'anachronism'. The foundation of the notion is the view, which pervades Aristotle's *Physics*, that 'qualities' require a neutral 'substrate' in which to inhere. But this whole conception is foreign to Plato, and arises from the unfortunate application of a logical distinction to physics. Every predicate is, of course, predicated about a *subject*. This suggests to Aristotle that the qualities we predicate of a thing 'inhere' in a 'substrate' which has no quality of its own. This is clearly an error in analysis. The *logical* subject (ὑποκείμενον) of which I predicate, e. g. 'red', is manifestly not a quality-less 'substrate', but the fully qualified sensible thing of which I say that it is red, the rose or what not which is before my eyes. On the harm done to the philosophy of Nature by this confusion of the subject of a predication with a supposed 'substrate' or 'stuff' (the 'matter' of materialists) see Whitehead *Concept of Nature* 17–25. It is precisely against it that Locke's criticism of the 'idea of substance' and all the most telling of Berkeley's anti-materialistic arguments are aimed. We must take Timaeus to mean exactly what he says. The ψυχαί are those of human persons, and with each such ψυχή there is associated one and only one star. This does not mean that if a certain star is mine I am the ψυχή of that star, any more than that the star is my body. The star has its own ψυχή, the ψυχή which conducts its axial rotation, and I have my own body, which is *not*, like the star, a globe mainly composed of fire. There is a certain tie between my ψυχή and the star, and that is all. In the mouth of Timaeus this association has no connexion with 'astrology'. The star meant is not a 'planet', and it was just the positions of the *planets* at the moment of a man's birth which were afterwards thought by the astrologers to be so important. But for their connexion with the benign or malign influences of planets the constellations would be much less important in a 'horoscope'. Timaeus does not even suggest that any one star is not as good to be associated with as any other. The object of the whole connexion is simply to place every soul in a position from which it can get a 'bird's-eye view' of the order and law which reigns in the 'great world' and should reign in the 'lesser world' of a man's soul. We are at liberty if we please to suppose that Timaeus means the return of the soul which has lived well to its 'home in the star assigned to it' literally. As for Plato himself, the entire absence of such details from the picture drawn of the soul's future in *Laws* x suggests that the fancy has only a symbolical value for him. In the main he dwells on two thoughts. The first is that there is a real affinity between the moral orderliness of the good life and the orderliness of the great cosmic movements, the same thought to which Kant gives a very characteristic turn in the famous closing paragraph of the *Critique of Practical Reason* about the 'starry heaven above and the moral law within'. The life of rule is really the 'life according to Nature', since the source of Nature's laws is itself a moral one, 'God's choice of the *best*'. The other thought is that the tendency to expect and look for intelligible laws out of which both science and codes of conduct arise is an original

and distinctive endowment of the human soul. The popular fancies which connect souls with stars, as shown for example in the belief that the birth or death of a great man is coincident with the blazing out of a star (*ecce Dionaei processit Caesaris astrum*), seem to be old enough, and the Pythagoreans may have inherited them, like their curious taboos, from a 'primitive' past. But what Timaeus is giving us is a highly moralized and spiritualized version of these beliefs.

41 e 1. ὡς ἐς ὄχημα. Here it is the star assigned to a man which is called his ὄχημα or 'car'. The Neo-Platonic speculations, of which we hear so much in Proclus, about the αὐγοειδὲς ὄχημα (the 'astral' body) and other grosser 'vehicles' which are successively attached to the soul as she descends lower and lower to her destined embodiment, take their (Platonic) origin not from this passage but from the *Phaedrus* myth, where we read (*Phaedrus* 247 b 2) of the ὀχήματα upon which the souls ride in the great procession up the 'steep ascent of heaven'.

41 e 3–4. ὅτι γένεσις πρώτη . . . πᾶσιν. The first 'birth' of all the souls is supposed to be out of the soil like that of the double-sexed creatures of Aristophanes' speech in the *Symposium* (196 b 7), or of the 'autochthonous' natives of Attica according to the Athenian legends playfully reproduced in the *Menexenus* (237 b–c). In the story of Timaeus the first living creatures are all human and without sex-differences, the differentiation of the sexes and the infra-human species coming about later by a kind of 'evolution by degeneration'. This is all that is meant by saying that the first 'birth' is to be one and alike for all. It does not mean that there are to be no individual differences in worth or capacity. The existence of such individual differences is implied by the phrase already used about the 'second *and third* brew' and is also needed to explain the 'degeneration'.

41 e 5. εἰς τὰ προσήκοντα . . . ὄργανα χρόνων. What ὄργανα χρόνων are we have already learned from 39 d 1 and see again from the reference to the 'earth, moon, and the other ὄργανα χρόνου' at 42 d 4–5. They are the earth and the planets. χρόνων (not χρόνου) is the only reading which has any MSS. attestation. The plural is used because, as we have been told, the revolutions of all the planets are just as much 'time' as those of the sun and moon. Note that Timaeus clearly means that *all* the planets are inhabited by beings who may properly be called 'men' because they are embodied reasonable souls. He does not mean that some of those who are to be 'men' on our earth are 'sowed' in the planets,[1] but that each planet produces its own αὐτόχθονες. There is evidence that this was really a fifth-century Pythagorean belief. Thus we read in the *Placita* (ii. 30. 1) that some Pythagoreans, including Philolaus [presumably this means 'Philolaus'?] believed the moon to contain finer vegetables and animals than the earth, and even said that lunar animals are fifteen times as large as ours.[2] The question whether there

[1] This is wrongly given as the meaning in *Timaeus Locrus* 99 d–e ὧν τὰς ψυχὰς ἐπιρρύτως ἐνάγαγε τὰς μὲν ἀπὸ σελάνας, τὰς δ' ἀπὸ ἁλίω, τὰς δὲ ἀπὸ τῶν ἄλλων τῶν πλαζομένων κτλ.

[2] *Placita* ii. 30. 1 (*Doxogr.* p. 361 = *Fr. d. Vors.*[3] i. 306–7) τῶν Πυθαγορείων τινὲς μέν, ὧν ἐστι Φιλόλαος, . . . γεώδη φαίνεσθαι τὴν σελήνην διὰ τὸ περιοικεῖσθαι αὐτὴν

are men in the moon is touched on in Plutarch's essay on the *Face in the Moon*, where it is suggested (934 f) that the moon is what Socrates means to describe in the myth of the *Phaedo* when he contrasts the 'true surface' of the earth with the hollow mist-filled lagoons in which we live.[1] There are traces of the survival of the same ideas in the view found in both Proclus and Macrobius that the moon is an *αἰθερία γῆ*. In commenting on 40 b supra Proclus makes a reference to the possible inhabitants of the planets, specially alluding to what is said in the present sentence, *εἰ δὲ καὶ μερικαὶ ψυχαὶ περὶ αὐτοὺς ἐσπάρησαν, ἄλλαι μὲν περὶ ἥλιον, ἄλλαι δὲ περὶ σελήνην, ἄλλαι δὲ περὶ ἕκαστον τῶν λοιπῶν . . . δῆλον ὅτι καλῶς εἴρηται κόσμον ἑκάστην εἶναι τῶν σφαιρῶν* (Diehl iii. 131. 18), and in dealing with our passage (ib. iii. 280. 22) he insists on the point that all the *στοιχεῖα* (planets) are inhabited, *ἐπειδὴ δὲ οὐ μόνον ἐπὶ τῆς γῆς ζῷα συνίστανται, ἀλλὰ καὶ ἐν τοῖς ἄλλοις στοιχείοις, οὐδὲ ἄνθρωπος μόνον (τοῦτο γὰρ ἡμῖν γνώριμον), ἀλλὰ καὶ ἄλλα ζῷα, θειότερα μέν, γενητὰ δὲ ὅμως κτλ.*[2] The evidence of Timaeus, the *Placita*, and Plutarch seems to me to show that this is a genuine survival of an old Pythagorean doctrine. At the end of the sixteenth century it was revived like the rest of Neo-Platonism, and it was presumably *this* feature in Giordano Bruno's doctrine of 'many worlds' (which naturally gave rise to awkward theological questions) that proved fatal to that philosopher. Fraccaroli correctly explains that T. means to assert that there are men in the planets, but seems not to know that this was a genuine Pythagorean view. Rivaud also has the point right.

42 a 1. ζῴων τὸ θεοσεβέστατον. A periphrasis for 'man', the one animal who has religion and worships gods. A.-H. compares *Laws* 902 b 5 *θεοσεβέστατον αὐτό ἐστι πάντων ζῴων ἄνθρωπος*. The thought was a commonplace. Plato makes the highly respectable but con-

καθάπερ τὴν παρ' ἡμῖν γῆν ζῷοις καὶ φυτοῖς μείζοσι καὶ καλλίοσι· εἶναι γὰρ πεντεκαιδεκαπλάσια τὰ ἐπ' αὐτῆς ζῷα τῇ δυνάμει μηδὲν περιττωματικὸν ἀποκρίνοντα, καὶ τὴν ἡμέραν τοσαύτην τῷ μήκει.

[1] Plut. loc. cit. *τὴν δὲ σελήνην οὐκ εἰκὸς ὥσπερ τὴν θάλασσαν μίαν ἔχειν ἐπιφάνειαν, ἀλλ' ἐοικέναι μάλιστα τῇ γῇ τὴν φύσιν, ἣν ἐμυθολόγει Σωκράτης ὁ παλαιός* (*Phaedo* 110 d), *εἴτε δὴ ταύτην αἰνιττόμενος, εἴτε δὴ ἄλλην τινὰ διηγούμενος κτλ.*

[2] Cf. Proclus *in Parmenidem* 131 d (Stallbaum p. 679 = Cousin v. 117) *ὥστε καὶ εἴ τινες ἄνθρωποι κατ' ἄλλας τοῦ παντὸς μερίδας κρείττους ἡμῶν ὑπάρχοιεν, καὶ τούτους μᾶλλον ἐγγὺς ὄντας τῆς ἀνθρώπου ἰδέας μᾶλλον αὐτῇ καὶ κατὰ πλείους δυνάμεις κοινωνεῖν·* i.e. they would have a better right to the name of 'man' than we have ourselves. Proclus (*in Timaeum* ii. 48 Diehl) apparently attributes to 'Pythagoreans' as well as to 'Orpheus' a theory that the Moon, Mercury, Venus, the Sun correspond respectively to the four 'roots' earth, water, air, fire, being *αἰθερία γῆ, αἰθέριον ὕδωρ*, etc.; the four 'outer' planets correspond to the same 'roots' in the reverse order. (This is also stated by Macrobius in *Somn. Scip.* I. xi. 10–12.) This development, as it stands, is clearly not ancient, since it has the Alexandrian order of the planets, but this does not prove that the 'Orphic' lines quoted by Proclus about the *ἄλλην γαῖαν ἣν τε σελήνην | ἀθάνατοι καλέουσιν, ἐπιχθόνιοι δέ τε μήνην* are equally late. The moon is called *γῆ ὀλυμπία* by one of the speakers in Plutarch's *De Facie in Orbe Lunae* (935 c); the question whether there are 'men' there is mooted at 937 d, but not taken seriously. It might naturally be raised at any time after the promulgation of the theory of Anaxagoras that the moon is 'earth'. Chalcidius (*Comment.* § 200, Wrobel, p. 241) says correctly 'iuxta Pythagoram quidem, quod ita ut in terra, sic etiam in lunari globo consistant homines et etiam in ceteris errantibus stellis', but goes on to give as 'iuxta se' (i.e. Platonic) a different and foolish theory that the souls who are to be born earliest are 'sown' in the earth, the rest in other planets.

ventional Protagoras dwell on it, *Protag.* 322 a 3 *ἐπειδὴ δὲ ὁ ἄνθρωπος θείας μετέσχε μοίρας, πρῶτον μὲν διὰ τὴν τοῦ θεοῦ συγγένειαν ζῴων μόνον θεοὺς ἐνόμισεν* κτλ.

42 a 2–3. τὸ κρεῖττον . . . ἀνήρ. *τὸ κρεῖττον*, not simply the 'stronger' but the 'superior'. This is quite consistent with the doctrine of Socrates expounded in *Rep.* v and in the *Aspasia* of Aeschines of Sphettus, that 'the *ἀρετή* of a woman and that of a man are the same', since it is admitted by Socrates in the *Republic* that the best performance of woman falls short of the best performance of man in all departments, 455 d 2 *πολὺ κρατεῖται ἐν ἅπασιν ὡς ἔπος εἰπεῖν τὸ γένος τοῦ γένους.* The *καί* in *ὃ καὶ ἔπειτα κεκλήσοιτο* = 'actually', 'indeed'. There is a hint at some derivation of the word *ἀνήρ* indicating the superiority of the *γένος* which has the name. Is the allusion to the etymology with which Socrates plays in *Cratylus* 413 e, where *ἀνήρ* is said to be derived from *ἄνω* and *ῥεῖν*?

42 a 3–b 1. ὁπότε δή . . . διεστηκότα. Sensation, pleasure, pain, desire (*ἔρως*), fear, anger are enumerated as characters not inherent in *ψυχή* as such, but arising from its conjunction with a body. Virtue consists in being master of all these emotions, vice is being mastered by them (42 b 1–2). When Plato is talking of the emotions and passions he usually mentions as typical *ἡδονή*, *λύπη*, *ἐλπίς*, *φόβος*, and *θυμός* and *ἔρως* are often added. *ἡδονή* and *λύπη* are what you feel in the actual presence of something believed to be a good or an evil, *ἐλπίς* and *ἔρως* are felt towards a supposed good, *φόβος* or *θυμός* towards a supposed evil, which is anticipated. Plato does not profess to regard this as a complete enumeration or classification. Hence, he at once mentions here the 'accompaniments of these states and their opposites'. Cf. the definitions in the *Ὅροι* (the early Academic character of this collection is shown by the large number of its items which are dialectically discussed in Aristotle's *Topics*), *φόβος ἔκπληξις ψυχῆς ἐπὶ προσδοκίᾳ κακοῦ, ἐλπὶς προσδοκία ἀγαθοῦ.* The Stoics took the list of four, *ἡδονή*, *λύπη*, *ἐλπίς*, *φόβος* (or alternatively *θυμός*) as a complete classification of the fundamental *perturbationes* or disorders of the mind, and went on to commit the 'intellectualistic' confusion of these emotions with 'judgements' (*κρίσεις*), so that pleasure and pain are identified with our belief that we are in present possession of good or evil, hope and fear with our judgement that good and evil are impending. The *locus classicus* for this is Cicero *Tuscul.* iv. 9 (R. P. 521), but see also the Greek form of the definitions in R. P. 521 c. The 'apathy' extolled by the Stoics meant simply the wise man's freedom from false judgements on these four points. One of the most important modifications made by Posidonius in the original Stoic doctrine, as a direct consequence of his Platonic studies, was his rejection of the identification of the *πάθη* with judgements, and his return to the Pythagorean-Socratic doctrine that they belong to the 'non-rational element' in the soul (the *θυμοειδές* and *ἐπιθυμητικόν*). Galen *de placit. Plat. et Hippocr.* iv. 7 (R. P. 535).

42 b 3–5. καὶ ὁ μὲν εὖ . . . ἕξοι. This reads at first as though a man who lived one life thoroughly well would get off all further incarnations. This would be inconsistent with the myth of the *Phaedrus*, according to

which even the best men have to live the 'philosophic life' three times in succession before they finally becomes 'winged' and escape the body (*Phaedrus* 249 a 3 *ἐὰν ἕλωνται τρὶς ἐφεξῆς τὸν βίον τοῦτον, οὕτω πτερωθεῖσαι τρισχιλιοστῷ ἔτει ἀπέρχονται*, ib. 256 b 4. But *τὸν προσήκοντα χρόνον* 'the due time' is an indefinite phrase and it is clear that it means more than one life-time. If the men who were too good to be reborn as women all departed to their 'stars', the women of the second generation would have no mates, the elaborate arrangements for sexual propagation would be useless, and mankind would die out. We must suppose that a great many, if not all, of the men who live too well to be reincarnated as women are reborn many times in order to account for the 'appearances'. We are not to suppose that the 'due time' is one and the same period for every man. It may be longer for some souls and shorter for others. It is assumed that the number of souls in the universe is constant, but the number of those who have earned their final discharge from the body is not. If we take Timaeus *au pied de la lettre* this raises a difficulty. The total population of the planets by incarnate souls can never increase, and steadily diminishes as any souls make their escape from the body. Can he be supposed to intend this? For some sensible remarks on the impossibility of absolute literalness of interpretation see the comments of Proclus on the passage. He escaped the particular difficulty just mentioned by holding that no soul ever *finally* escapes from the 'wheel of birth', all have periodically to 'descend to generation'. But Timaeus clearly thinks of the return to the 'star' as final.

42 b 3–5. *πάλιν . . . ἕξοι.* This is the one passage in Plato to which Dante, who knew it from the version and commentary of Chalcidius, definitely takes exception on theological grounds, since it conflicts with the doctrine that all the souls of the saved are together in the 'empyrean' or highest heaven, beyond the limits of '*this* world'. Dante himself is careful to explain that what he sees in the different planetary 'spheres' and the *ἀπλανὲς* are merely symbolical visions; the souls of the saints are 'really' where he sees them in the final vision of the great white rose.

Paradiso iv. 22. Ancor di dubitar ti dà cagione
parer tornarsi l'anime a le stelle,
secondo la sentenza di Platone.

ib. 49. Quel che Timeo de l'anime argomenta
non è simile a ciò che qui si vede,
però che, come dice, par che senta.

Dante adds, however, that perhaps Timaeus only meant that the 'stars' exercise various 'influences' for good or evil on human life, and that if he meant this, he was right, though all idolatry has arisen from misunderstanding of this truth (ib. 55–62). Cf. the allusion of *Convivio* iv. 21 'Veramente per diversi filosofi della differenza delle anime nostre fu diversamente ragionato . . . Plato e altri volsero che esse procedessero da le stelle, e fossero nobili e più e meno secondo la nobilitade de la stella'. However, in both places Dante takes the 'star' to be the planet which governs a man's 'nativity'.

42 b 5. εἰς γυναικὸς φύσιν. The anatomical and physiological readjustments required are described *infra* 90 e ff. It is not likely that any part of the story was regarded by Plato himself as more than a parable. In *Laws* x, where we get the Platonic natural theology, all that we are told as *doctrine* is that the soul is immortal, and that in virtue of the law that 'like is drawn to like' its lot is cast among others who are on its own level of virtue and wisdom or vice and folly, and it seems to be hinted that this is the real moral of the tales of rebirth in different forms (*Laws* 904 e 4 *αὕτη τοι δίκη ἐστὶ θεῶν οἳ Ὄλυμπον ἔχουσιν, ὦ παῖ καὶ νεανίσκε ἀμελεῖσθαι δοκῶν ὑπὸ θεῶν, κακίω μὲν γιγνόμενον πρὸς τὰς κακίους ψυχάς, ἀμείνω δὲ πρὸς τὰς ἀμείνους πορευόμενον, ἔν τε ζῳῇ καὶ ἐν πᾶσι θανάτοις πάσχειν τε ἃ προσῆκον δρᾶν ἐστι τοῖς προσφερέσι τοὺς προσφερεῖς καὶ ποιεῖν.* So the rebirth of the man who does not make the very best of his opportunities as a woman, i.e. with a handicap against him, is a case of 'to him that hath shall be given, but from him that hath not shall be taken away even that which he seemeth to have'. The doctrine was originally based on a literal acceptance of the kinship of men with animals which made it seem perfectly credible that a man's soul should enter a beast's body or a beast's soul a man's body. It is unlikely that even Timaeus means to insist on the literal truth of such stories. The moral lesson is contained in the words *κατὰ τὴν ὁμοιότητα τῆς τοῦ τρόπου γενέσεως*, 'according to the nature of his evil *τρόπος*', 'answerably to his character' (*ἡ τοῦ τρόπου γένεσις* being a periphrasis for *ὁ τρόπος*), and the whole phrase, as Stallbaum says, meaning simply *κατὰ τοῦτον τὸν τρόπον ὃν κακύνοιτο.* The compiler of the *Timaeus Locrus* ends with a reference to this passage in which he hints that the whole story of rebirth in animal forms is a fiction with a wholesome moral, adding that if you cannot make an impression on a perverted mind by true stories it is well to do so by false ones, and praising Homer for his pictures of the punishment of the great sinners in the underworld (*Tim. Locr.* 104 c *εἰ δέ κά τις σκλαρὸς καὶ ἀπειθής, τῷ δ' ἐπέσθω κόλασις ἃ τε ἐκ τῶν νόμων καὶ ἃ ἐκ τῶν λόγων, σύντονα ἐπάγοισα δείματά τε ὑπουράνια καὶ τὰ καθ' Ἀιδεω, ὅθι κολάσιες ἀπαραίτητοι ἀπόκεινται δυσδαίμοσι νερτέροις, καὶ τἄλλα ὅσα ἐπαινέω τὸν Ἰωνικὸν ποιητὰν ἐκ παλαιᾶς ποιεῦντα τὰς ἐναγέας κτλ*).

42 c 4–d 2. πρὶν τῇ ταὐτοῦ . . . εἶδος ἕξεως. This is the first intimation we get that there are 'circles' in the human head which correspond to the two great cosmical circles of the Equator and Ecliptic. We shall hear more about this directly. Of course we should expect that as the *ψυχή* of the great world has these circles, the *ψυχή* of man, the 'microcosm', would have them too. The historical origin of the doctrine seems to be in the physiological theories of Alcmaeon of Crotona, a younger contemporary of Pythagoras, who was the first man to recognize the central importance of the brain in the sensory-motor system and the founder of empirical sense-psychology, besides being the originator of the medical doctrine that health is dependent on the 'balance of the constitution' (*ἰσονομίη*) in the body. Alcmaeon is reported to have said that the reason why men die is that they cannot 'make both ends meet'; the 'wheels' in our heads, unlike those in the macrocosm, do not always 'come full circle'. [Aristot.] *Probl.* 916 a 33 *τοὺς ἀνθρώπους φησὶν* A. *διὰ τοῦτο*

ἀπόλλυσθαι ὅτι οὐ δύνανται τὴν ἀρχὴν τῷ τέλει προσάψαι. To complete the theory we have to add that though man is mortal his ψυχή is immortal, because it is 'always in motion', like the sun and moon. As Aristotle says of him (*de Anima* A 405 a 30) 'he says that the ψυχή is immortal because it is like the immortal things; now it is so in virtue of being always in motion. For the divine things, too, are always in continuous motion, the sun, moon, ἀστέρες (i. e. planets), and the οὐρανός as a whole.[1]

If we take Timaeus to be speaking precisely, he seems to say that no soul which has been reborn as a woman or a lower animal will ever regain its 'star' until, after a long period of purgation, it has been born once more in the best form, i. e. as an ἀνήρ. He may, of course, have forgotten that he began the sentence with a reference to the case of the second-best men who are reborn as women at b 5, and may only intend to say of those who have sunk lower that they have to be human beings again, i. e. the πρώτη καὶ ἀρίστη φύσις may mean 'man' and not 'the male sex'. Proclus insists that we cannot suppose Timaeus really to mean that every woman is a reincarnated male human being or that no woman can 'go to heaven' direct. Accordingly, he supposes that Timaeus is not speaking of the distinction of sex at all but of the 'virile' and 'effeminate' types of character, each of which may be shown by either sex. But this comes of supposing that Plato is teaching for doctrine everything which Timaeus says. As to the meaning of the mere words, I think they do mean that a woman does not earn her discharge until she has been reborn as a man. But the meaning of the parable is simply that if you have not made proper use of your opportunities, you have not only a purgation to undergo, you have to 'get your chance' again and show that you have learned the lesson of purgatory by using the chance better the second time. And it is quite credible that in the 'primitive' beliefs on which the whole passage is founded it was seriously held that women have to be reborn as males. (Even some of the early Christian Fathers held a similar view, and St. Thomas actually takes the trouble to confute it, *Summa contra Gentiles* iv. 88, *de sexu et aetate resurgentium*, 'similiter etiam nec infirmitas feminei sexus perfectioni resurgentium obviat', etc.)

42 d 1. λόγῳ κρατήσας. Not 'by reason', a sense of λόγος which can hardly be substantiated for any philosophers earlier that the Stoics, but 'by rule', by the *vita sub disciplina*. So the ἄλογον ὄντα immediately before means not 'irrational', but 'without ratio', or more generally 'unregulated', 'without measure'.

42 d 2–e 4. διαθεσμοθετήσας . . . αἴτιον. The souls are now deposited like seeds in the earth and the different planets—from which they will in due time emerge as the πρώτη γένεσις 'first generation' of ἄνθρωποι. While they await this due time, the 'created gods' fashion bodies for them and make such adaptations in the soul itself as it will need in its embodied life. Stripped of metaphor this means that the soul as we know it has various characteristics which are only required because of its association with the body. Since this association is temporary, these

[1] *loc. cit.*

characters are themselves incidental and not permanent. Socrates hints the same thing in the well-known passage of the *Republic* (x. 611 d–612 a), where he says that we cannot expect to understand the real nature of the soul and to say whether it is truly one or many so long as we only know it as it is in its conjunction with the body. To arrive at true views about it, we must look at its 'passion for truth' (*τὴν φιλοσοφίαν αὐτῆς*) and consider not 'what it now is' but what it 'aspires to be' (*καὶ ἐννοεῖν ὧν ἅπτεται καὶ οἵων ἐφίεται ὁμιλιῶν*). This is meant there as a hint that the distinction of the three 'parts' (*μόρια*) or 'constituents' (*εἴδη*), the *λογιστικόν, θυμοειδές, ἐπιθυμητικόν*, which we find as an empirical fact in our every-day life, would vanish in a soul which had become what all souls, consciously or not, strive to be. So we shall find Timaeus describing the *θυμοειδές* and *ἐπιθυμητικόν* as the *θνητὸν ψυχῆς εἶδος*, the 'perishable constituent in soul', a passing adjunct intended to fit the really immortal *ψυχή* for its temporary 'house'. The coincidence at once suggests the view that the whole doctrine of the 'tripartite soul', familiar from its use in the *Republic*, is Pythagorean, and no novelty introduced by Socrates, still less a 'discovery' of Plato's own.

42 d 3–4. *ἵνα τῆς ἔπειτα εἴη κακίας ἑκάστων ἀναίτιος.* So in the myth of Er it was insisted that *αἰτία ἑλομένου· Θεὸς ἀναίτιος.* Thus the point which Socrates labours so earnestly in *Rep.* ii that God is in no sense the cause of human sin seems to be Pythagorean also, as indeed most of the *Republic*, except the special political developments, is. We shall need to bear the emphatic language of this passage in mind when we come to discuss the question whether the 'medical psychology' put into the mouth of Timaeus at p. 90 means that Plato is committing himself to 'scientific determinism'.

42 d 5–6. *τὸ δὲ μετὰ τὸν σπόρον.* Adverbial accusative, 'now, after the sowing', not object. accus. after *παρέδωκεν*, which means simply 'he made over the task of . . .'.

42 d 7. *τό τ' ἐπίλοιπον.* Again adverbial, 'and *besides*, to make and control all that must yet be added to a *human* soul, and whatsoever is consequent on those tasks' (viz. the making of the body and of the perishable adjuncts of the *ψυχή*).

42 e 3. *τὸ θνητὸν διακυβερνᾶν ζῷον.* The metaphor is from navigation. The 'created gods' are, under the 'immortal God', 'captains of our salvation', though only of our temporal salvation. So God himself is said *κυβερνᾶν* 'to set the course' of the world at large. Socrates, too, is made by Plato, no doubt because it was his actual habit, to illustrate the regulation of conduct and the Providence of God, specially from the three familiar callings of the shepherd, the physician, and the navigator. Thus in *Rep.* i it is these three employments which are used to illustrate the 'disinterestedness' or 'impersonality' of all genuine *τέχναι*. There are several things worthy of note about this selection of illustrations. They are all eminently natural, and the selection of the shepherd and the navigator specially natural in a thinker taking his examples from the daily avocations of a people of small farmers and coasting traders. All three are common in other literatures. In Greek literature the shepherd metaphor meets us as early as Homer, who calls the Atridae, the two

commanders-in-chief of the great expedition against Troy, *ποιμένε λαῶν*. We know the metaphor primarily from its frequency in Scripture, 'Woe to the faithless shepherds', 'the Lord is my shepherd', 'he—the promised king—shall feed his flock like a shepherd', 'I am the good shepherd', etc., and it is worth noting that the Vulgate habitually uses the word *regere* in passages where the LXX has *ποιμαίνειν*, and the A. V. the mention of the shepherd. (E. g. Ps. xxii. (A. V. xxiii) 1 'Dominus *regit* me, nihil mihi deerit'.) The nautical metaphor goes back in Greek at least to the verses of Alcaeus, imitated in Horace *Carm.* i. 14, *ἀσυνέτημι τῶν ἀνέμων στάσιν*. So Aeschylus opens the *S. C. T.* with it, *ὅστις φυλάσσει πρᾶγος ἐν πρύμνῃ πόλεως, | οἴακα νωμῶν*, and it is common enough later. We do not find it in the Bible; the Hebrews were never a sea-going race. But it is naturally frequent in our own literature, which, like that of the Greeks, is the work of born sailors and merchants by sea. Cf. Dryden's lines about Achitophel, 'A daring pilot in extremity, Pleased with the danger, when the waves went high He sought the storms, but for a calm unfit, Would steer too nigh the sands, to boast his wit'. So we have all heard of the hackneyed glorification of Mr. Pitt as the 'pilot who weathered the storm'. In modern newspaper slang 'the man at the helm' is almost a *vox propria* for the Prime Minister. The 'physician' of the soul, or of the 'body politic', again, is as common in the Bible and in English literature as in Greek. All these metaphors are moreover prominent in the language of Pythagoreanism and its congener Orphicism. Thus in the Orphic myth related by the Eleatic speaker in the *Politicus* God is said to be the captain (*κυβερνήτης*) who alternately holds the helm of the world-ship (the *πηδάλια οἴακος* 272 e 4) and retires into his look-out (*εἰς τὴν αὐτοῦ περιωπήν*, ib. 5), leaving the vessel to drift of itself over the 'sea of variety' (273 e 1[1]) in which it would ultimately founder if the captain did not return to the tiller in time. So we are told at *Placita* ii. 4. 15 (*Doxogr.* 332) that 'Philolaus' (i.e. the Pythagoreans who taught the doctrine of the central fire) called the central fire the *τρόπις* or 'keel' of the *κόσμος*. The *δαίμων ᾗ πάντα κυβερνᾷ* of the second part of the poem of Parmenides (Fr. 12 in *Fr. d. Vors.*[3] i. 161 = R. P. 125), who is 'in the middle' of everything, and is apparently called, like the goddess of the myth of Er, Ananke (Parm. *Fr.* 10 = R. P. 123), clearly also belongs to this Pythagorean group of ideas. The metaphor appears, in fact, to have been used by Anaximander. The words *περιέχειν ἅπαντα καὶ πάντα κυβερνᾶν*, introduced by Aristotle in a passage of the *Physics* (Γ 203 b 7 ff. = R. P. 17), where he is discussing Anaximander's account of the 'boundless', are so unlike Aristotle's own phraseology that one naturally suspects an actual quotation. The same metaphor perhaps lingers on in our colourless word 'matter', a translation of Aristotle's *ὕλη*. Aristotle seems to have taken this technicality from

[1] loc. cit. *ἵνα μὴ χειμασθεὶς ὑπὸ ταραχῆς διαλυθεὶς εἰς τὸν τῆς ἀνομοιότητος ἄπειρον ὄντα πόντον δύῃ*. (MSS. *τόπον*.) Stallbaum rightly insists, however, that *πόντον* must be the true text, though he had not the hardihood to print it. Apparently he did not know that Proclus had *πόντον* in his text. The corruption must be very ancient, since Plotinus quotes the sentence with *τόπον* (unless, indeed, the MSS. of Plotinus are themselves corrupt here, as may be the case).

the very common every-day meaning of ὕλη, 'ship's timbers'. (Neither of the other two familiar senses, (*a*) forest, (*b*) fuel, would be likely to suggest the use of the word for the supposed 'substrate' or 'raw material' of natural processes.) The metaphor is kept up in the word συνεκόλλων used below (43 a 2) of the making of the *compages* of the human body (where the image is taken from *pegging* the planks of the ship together, not from glueing). Cf. *Menexenus* 236 b 6, where Socrates says that Aspasia made up the λόγος ἐπιτάφιος which he is just about to repeat by 'hammering together' fragments from the famous ἐπιτάφιος of Pericles, περιλείμματ' ἄττα ἐξ ἐκείνου συγκολλῶσα, and the frequent use of κολλᾶν for the welding of metals.

42 e 3–4. ὅτι μὴ . . . αἴτιον. The 'created gods', like the supreme God, are not responsible for the mischief a man causes by his own wilful folly. Timaeus is specially thinking of the harm a man may do to his own bodily health by neglect, ignorance of the laws of physiology, vice, and the like. The forces that 'mould our frame' are not answerable for this.

42 e 5—44 d 2. Καὶ ὁ μὲν . . . διεξιτέον. The making of the human body; a general description of the process, preliminary to the details.

42 e 5. ἔμενεν. On the force of the imperfect see C. W. p. 88, and for examples of a similar combination of imperfect with aorist in the sense 'proceeded to', 'went on to', cf. Madvig *Greek Syntax* (E. Tr.) p. 91, *Rem.* 2 on § 43. Proclus, who quotes the words more than once, explains the force of the tense correctly. 'When he had appointed all these tasks, he *proceeded to* abide, &c.', i.e. '*returned* to his rest'.

42 e 7. τάξιν. If this is the true reading it apparently means the 'plan', 'disposition', 'arrangement' indicated by the Creator's speech. But I do not feel sure that the reading of F πρόσταξιν is not the correct one, the προς- having been lost in AY after the τρος of πατρός. Proclus *seems* to show a knowledge of both readings as he has (iii. 316. 1) νοοῦσι τὸ τὴν τοῦ πατρὸς τάξιν, but ib. 24 ἔπονται τοῖς ἐκείνου προστάγμασιν. Cicero has 'parentis *ordinem*', so that he read τάξιν or διάταξιν: Chalcidius, who has *iussionem*, should mean this for πρόσταξιν. The ἐπείθοντο seems to me to make rather in favour of πρόσταξιν.

42 e 9–43 a 1. δανειζόμενοι . . . ὡς ἀποδοθησόμενα πάλιν, 'on the condition that the loan should one day be repaid'. The material of which our bodies is made is only *lent* for a time. For the thought cf. the piquant saying quoted in [Plat.] *Axiochus* 367 b 2 ff., probably from Epicurus, against whom the dialogue is aimed, κἂν μή τις θᾶττον ὡς χρέος ἀποδιδῷ, τὸ ζῆν, ὡς ὀβολοστάτις ἡ φύσις ἐπιστᾶσα ἐνεχυράζει τοῦ μὲν ὄψιν, τοῦ δὲ ἀκοήν, πολλάκις δὲ ἄμφω. 'Nature is like a small money-lender; if we do not repay the debt of life promptly, she comes down on us and takes sight or hearing, or often both, as pledges for a settlement.' More familiar to us is the imitation of the words by Lucretius (iii. 971) 'vitaque mancipio nulli datur, omnibus usu'. Cf. also our own phrase to 'pay the debt of nature', and Shakespeare's 'We owe God a death', and contrast 'the *gift* of God is eternal life'.

43 a 2. οὐ τοῖς ἀλύτοις . . . δέσμοις. Since in *them* soul and body were bound so fast that they are ἄλυτα without a direct 'miraculous'

interposition of the Creator's will. In us the 'fastenings' are only designed to hold for a certain time, after which the timbers of the ship 'start'. We shall hear more of this in the medical section of the dialogue.

43 a 3. συντήκοντες. The metaphor passes easily from that of the fastening of the planks of a ship by γόμφοι 'rivets' into that of the 'soldering' of metal plates.

43 a 5—44 b 1. What is now to be explained is the mental confusion and helplessness of the infant, to whom the world is one 'buzzing, blooming confusion'. The soul, united to a body which is like a 'never-resting stream' (ἐπίρρυτον καὶ ἀπόρρυτον σῶμα), is at first overpowered by the current, and the movements of its two circles are completely perturbed. The main guiding thought is that our chief business in early infancy is to grow. Plato himself says in the *Laws* (788 d 7) that a child grows as much in its first five years as in the whole of the rest of its life. Foreign material is being poured in on the body (ἐπίρρυτον) and carried off again by perpetual evacuation (ἀπόρρυτον). In fact, a baby's business in life is much the same as a caterpillar's. Timaeus is a medical man as well as an astronomer, and we are able to take the 'stream' into which the soul is plunged in this homely and quite literal sense. (Cf. the name χαραδριός, from χαράδρα, given to a bird,[1] of whom it was fabled that it is so greedy that it eats and evacuates at the same time, so that its food runs through it in a steady stream.) It is a secondary point that the novelty of the baby's sensations, as its random movements make it acquainted with the painful facts that fire burns and hard things bruise, goes to swell the confusion. Hence the circles only settle down to their proper motion when waste and repair in the body begin to balance one another, i.e. when we come to our ἀκμή, and even so, παίδευσις, education, is necessary to establish the proper revolutions accurately. Thus what Timaeus is explaining by his pyscho-physiology is the doctrine of ἀνάμνησις expounded in the *Phaedo* and *Meno*. When we come as babies into this world we forget what we had known about the law of Nature and of life; it is as we advance towards manhood, and then only if we get 'education', that we can 'recall' or be 'put in mind' of this lost knowledge. ἀνάμνησις does not mean *memory* (the mere retention of knowledge), but the *recall* of something which has been forgotten. Hence the fancy, used by Wordsworth in his famous *Ode*, that 'heaven lies about us in our infancy', but the 'vision fades away' as we grow into intelligence, and manhood actually contradicts the Pythagorean doctrine it is popularly supposed to express, exactly as the notion that babies in their cradles are aware of the first principles of science contradicts the theory of Descartes about 'innate ideas'. We should not need to be 'put in mind' of anything which we had not first forgotten. The *Phaedo* is quite clear on the point. We are told there at 76 d that our birth is just the time when we 'forget'. Wordsworth gets the statement right when he says that 'Our birth is but a sleep and a *forgetting*', but his stanza about the 'clouds of the prison-house' which 'begin to close upon the growing boy' is quite false to the theory. According to the *Phaedo* and *Timaeus* it is science which opens the doors of the prison in which we were enclosed at birth.

[1] The stone-curlew, according to Prof. D'Arcy Thompson.

The description of the baby's first experiences of fire, hard stones, and the like raises an interesting question, which we cannot perhaps answer over-confidently. The point seems to be that it is from the violence of the *shock* given to the infant body by a burn, or a bruise, or the like that the 'circles' in the soul are thrown into confusion. This might suggest that it is not αἴσθησις—awareness of sense-data—as such; but sensation attended by violent organic shock, 'intrusive' sensation, which is regarded as a consequence of the conjunction of the soul with an ἐπίρρυτον καὶ ἀπόρρυτον σῶμα. So at 42 a 5 it was αἴσθησις ἐκ βιαίων παθημάτων that was spoken of as peculiar to the incarnate soul. It is possible then that Timaeus does not mean to say that a disembodied soul has no αἰσθήσεις, but only that it would have none which are accompanied with this sense of shock, because the shock is due to the fact that all unduly violent αἰσθήσεις are hostile to the body's well-being. I suspect that even the disembodied soul is supposed to have αἰσθήσεις, since it has in it the circle of the Other, whose function is to yield true δόξαι about αἰσθητά. Without αἴσθησις there would hardly be any δόξαι. All judgements would be about νοητά, and therefore all those of them that were true would be *aeternae veritates*, and would belong to ἐπιστήμη. If the soul delivered from 'the burden of the flesh' has no αἰσθήσεις, it should seem that it can think only about metaphysics, and theology, and pure mathematics. The ascription of a 'circle of the Other' to the soul before 'it is conjoined with the body seems to show that Timaeus does not confine its thinking within these limits. We cannot be sure that he had put the question *utrum anima a corpore seiuncta cognoscit sensibilia* to himself, but if he were to do so, I take it he would have to say that even a soul without a body would, or at least might, be aware of sense-data (tones, colours, &c.), but that, as it has no body to be endangered, its apprehension of them would not be conditioned, as ours is, by the fact that all apprehension of sense-data of more or less than a certain 'medium' intensity is injurious to the organism. The sensations of such a soul would never be 'intrusive'. It would follow that escape from the flesh, so far from putting an end to our perceptions of colour, tone, and the like, might even increase their range. The disembodied soul might conceivably perceive colours beyond the red and violet ends of the spectrum.

43 a 7. οὔτ' ἐκρατοῦντο . . . ἔφερον, i. e. the circles in the soul neither completely swayed the motions of the body, nor were their own motions absolutely stopped; there was mutual interference of soul with body and body with soul, the result being that the whole ζῷον made random and lawless movements in each of the six possible directions forwards—backwards, up—down, right—left. The motions described are the random experimental movements of early infancy. These are neither simply movements of ψυχή nor mere movements of σῶμα, but movements of the ζῷον, the complex of ψυχή + σῶμα. They show their connexion with ψυχή by being 'spontaneous'; the baby is not simply pushed and pulled by physical forces. They show their dependence on σῶμα by their 'random' character and want of definite 'co-ordination'. The passage is a striking example of excellent psychological observation.

43 b 1. προιέναι. A good example of the value of F. Until it had

been collated the MSS. evidence seemed in favour of the obviously false προσιέναι.

43 b 7. τὰ τῶν προσπιπτόντων παθήματα. St., M., A.-H., to judge by their renderings, all take παθήματα here to mean the *effects* produced in the percipient by contact with a foreign body; I think it means rather simply the *qualities* of the foreign bodies themselves. If a baby grabs at a bright burning coal it is burnt . . . Timaeus, I believe, rightly regards τὸ θερμόν in this case, in the way of *naïf* realism, as a quality of the coal, not as a 'subjective' effect 'in' the percipient. Perhaps St. means this too by his comment 'non tantum ipsius corporis naturae mutatio sed etiam sensuum perceptiones iudicantur tantam efficere in animis perturbationem et inconstantiam'. The mental confusion is ascribed by Timaeus to two causes, (*a*) the actual changes produced by nutrition in the growing organism, (*b*) the shock attending the perception of the sensible qualities of bodies around us. In b 5, above, the subject of προϊέναι is τὰ ζῷα, suggested by the preceding ὅλον κινεῖσθαι ζῷον.

43 c 1. πυρὶ ἀλλοτρίῳ. The ἀλλοτρίῳ is added, as A.-H. says, because Timaeus holds that there is οἰκεῖον πῦρ, fire which forms a part of us in our own bodies, particularly in the eye. But A.-H. should have noted that the qualification ἀλλοτρίῳ belongs in sense, though not in grammar, to all the datives. There are also γῇ, ὕδωρ, ἀήρ in the constitution of our own body as well as in foreign bodies.

43 c 2. στερεῷ here equivalent to σκληρῷ, 'a *hard* lump of earth'. Timaeus is thinking of the baby's first experiences of falling or striking against something which makes a bruise.

43 c 5–7. αἳ δὴ . . . κέκληνται. There cannot be much doubt that in saying that these experiences, no doubt (δή), came to be called αἰσθήσεις for the reason given, and still retain the name, Timaeus is alluding to some etymology of the word αἴσθησις. He does not say what the etymology intended is, but merely indicates by the φερόμεναι of c 5 that he means to derive αἴσθησις from some word denoting rapid *motion*. Proclus thought that the allusion is to Homer Π 468 ὁ δ' ἔβραχε θυμὸν ἀΐσθων, and possibly also to ἀΐσσειν, in connexion with which he refers to the first definition of αἴσθησις at [ὅροι] 414 c as ψυχῆς φορά. M. and A.-H. adopt the view that the allusion is to ἀΐσσω, and it certainly seems the most probable. The *Cratylus* is full of such fanciful etymologies. Since Socrates is there represented as improvising them under a sort of temporary 'possession', and professes to be able to demonstrate equally well from them the Heraclitean doctrine of flux or the Eleatic denial of the reality of motion, Plato clearly thought such etymologies are no more than entertaining fancies, ingenious guesses at the original meaning of words, some of which might turn out to be sound. The persons known to have made most play with this appeal to supposed etymologies are the Heracliteans, but since some of the guesses given in the *Cratylus* are said to be 'Orphic' (e. g. the derivation of σῶμα from σῴζειν, the body being the 'ward' in which the soul is 'kept safe' until it has 'paid its debts'), the Pythagoreans are likely enough to have dabbled in these speculations too.

43 c 7—44 b 1. καὶ δὴ καὶ τότε . . . ἐνδεθῇ θνητόν. Two psychological

facts about our early years have then to be remembered: (*a*) babies do not reflect or think. The 'circle of the Same' in their souls is at first actually arrested (*παντάπασιν ἐπέδησαν*, d 2); (*b*) even their sense-perceptions are hopelessly inaccurate and confused until they have *learned* to see and hear (*τὴν δ' αὖ θατέρου διέσεισαν*, d 3–4), and the confusion is made worse by the violent organic shock caused when the baby's random movements bring it into sudden and violent collision with a foreign body (43 e 8–44 a 5). This is why a baby is at first *ἄνους*, 'silly'.

43 d 4–e 4. ὥστε τὰς τοῦ διπλασίου . . . ὑπτίας. This is intended to explain why we do not actually hear the 'music' of the heavenly bodies. To hear it, we require that the 'circles' in our own souls should 'vibrate in sympathy' with those in the heavens, but the shock of association with the body has perturbed all the motions of our own 'circles' in all sorts of ways. Hence they do not execute the requisite sympathetic vibrations. The restoration of the true periodic rhythm of the movements of the 'circles' is the last achievement of 'education'. But it is suggested that the *φιλόσοφος* may in the end 'correct' the behaviour of his 'circles', and therefore presumably does end by discerning the music (44 b 8–c 4).[1] Of course he does not hear it with his ears; it is one of the 'unheard melodies' which are sweeter than the 'heard'. A less subtle explanation of our deafness to the tune of the stars is that assigned as Pythagorean by Aristotle *de Caelo* B 290 b 25, that we are unconscious of it precisely because it is always sounding in our ears (*αἴτιον . . . φασὶν εἶναι τὸ γιγνομένοις εὐθὺς ὑπάρχειν τὸν ψόφον, ὥστε μὴ διάδηλον εἶναι πρὸς τὴν ἐναντίαν σιγήν*). I suspect that Timaeus means directly to oppose this explanation; on his view it is not true that we hear the melody *εὐθὺς γιγνόμενοι*.

43 d 6–7. ἐπειδὴ παντελῶς λυταὶ οὐκ ἦσαν κτλ. This is in virtue of the principle already laid down at 41 a 7–8, which applies to the human 'immortal soul' as well as to the 'created gods', since it too is the immediate handiwork of God (41 d 4–7). The appeal here to the words of the Creator's speech strongly bears out the view we adopted of the text, which made 41 a 7–8 a complete enunciation, not an exclamation.

43 e 1. διαφθοράς. Another good example of the worth of F. This, the manifestly true text, might have been taken, but for F, as a mere conjecture of the *diorthotes* of A. Probably the common source of F and A had both words as variant readings.

43 e 3. ἀλόγως δὲ φέρεσθαι. *ἀλόγως* again = without *λόγος* in the mathematical sense of *ratio*. We were told at 36 d 6 that the motions of the circles in the heavens are all *ἐν λόγῳ*, i. e. that the period of every revolution has to that of each of the rest the *λόγος* of an integer to an integer. The perturbations consequent on birth into the body upset the 'ratios' between the movements of the corresponding circles in our souls, so that they are no longer 'rational' fractions, but 'surds'.

43 e 4. ἀντίας . . . πλαγίας . . . ὑπτίας. Three forms of perturbation corresponding to the three 'dimensions' *μῆκος*, *πλάτος*, *βάθος*. The

[1] Thus we see why, at least *one* reason why, *φιλοσοφία* is *μεγίστη μουσική*. Of course there are other reasons.

disturbance may cause the movement to be 'wrong way on' (*ἀντία*), or may shift it to the right or left of the proper course (*πλαγία*), or finally may 'invert' it, make it 'upside-down' (*ὑπτία*).

43 e 4–8. *οἷον ὅταν ... φαντάζεται.* An illustration of the kind of confusion produced by the perturbation of the 'circles' from the simple case (suggested by the word *ὑπτίας*) of a man who is 'standing on his head'. It seems to me that the example is really simpler than is assumed either by Proclus or by A.-H., who criticizes his explanation. In *πρός τινι* the *τινι* is neuter, and A.-H. rightly translates 'supporting his feet against something'. The sense then is that if a man 'stands on his head, supporting his feet in the air (*ἄνω*) against something, "in that condition" the right-hand side of the man himself (*τοῦ πάσχοντος*) and of the spectators appear left-hand, and the left-hand side right-hand to the other party'. This is manifestly true. If I am a spectator looking at you and you are in your normal position, I call that side of you which is opposite my left your right side, and you do the same for me. If, however, one of us is standing on his head, *each* party, unless he allows for the inverted position, will also call that side of the other which is opposite his own left the 'right' side, and both will be wrong. The parties concerned are the man who is 'on his head' and those who see him. The special case of a man on his head *directly* fronting a second man 'on his feet' does not come in. *τοῦ πάσχοντος* and *τῶν ὁρώντων* depend on *τὰ δεξιά* and *τὰ ἀριστερά*, not *τῷ πάθει*.[1]

44 a 2–3. *τότε ... γεγόνασι*, i. e. just as we confuse a man's right and left hand if we do not allow for the fact that he is *ὕπτιος*, so when the movements of the 'circles' are reversed or inverted, we make mistakes about identity and difference.

44 a 5–7. *αἷς δ' ἂν ... δοκοῦσι.* The antecedent to *αἷς* is *περιφοραί* in the last line of 43 e, 'when sensations rush in violently on the revolutions'. The *αὗται* of a 7 are, of course, *περιφοραί*, not *αἰσθήσεις* as St. supposed. It is of the 'revolutions' that *κρατεῖν* and *κρατεῖσθαι* have been used all along.

44 a 6. *τὸ τῆς ψυχῆς ἅπαν κύτος.* *τουτέστι τὴν ὅλην αὐτῆς οὐσίαν*, Proclus and so St., M., and A.-H. But what is the difference between this case and that already dealt with? We have just been told that in that case there is no 'dominating' *περίοδος*. In this second case the confusion is worse, for revolutions which are really 'dominated' are supposed to 'dominate'. But does not the 'soul as a whole' come equally into play in both cases? The difference seems to be that in the first case, though we do make a judgement, we make a false one; in the second, we make no judgement at all, but are swept on blindly by the current of 'sensation' without so much as mistaken reflection. Hence the second case must be that of 'intensive' sensations accompanied with violent organic 'shock'. Is the reference to the *ἅπαν κύτος* then to the emotional side of these disturbances, so that Timaeus really means by the

[1] Fraccaroli, like Chalcidius, Proclus, M., supposes the *τινί* of e 6 to be masc., but for a bad reason, viz. that 'it matters little whether the man's feet are supported'. But, of course, if they were not, he would find it hard to carry out the observations of which T. speaks.

whole κύτος, the 'mortal' as well as the 'immortal' constituents of ψυχή? (E. g. when a child is thrown into terror by the sight of the friendly demonstration of a dog, there is not only a 'mistake' but a painful emotional effect.) Or does not the κύτος of the ψυχή mean the receptacle in which it is placed, i. e. the body, so that the sense is 'when a sensation which affects the whole bodily organism profoundly occurs'? Cf. the use of κύτος at 78 c 1 *infra*. In any case Timaeus means that when we surrender ourselves to mere impulse without reflection, we suppose ourselves often enough to be acting 'freely', acting from within, whereas really our behaviour has been simply determined for us by stimulation from without.

44 a 8. νῦν κατ' ἀρχάς τε. Tr. in order to get the emphasis right, 'these affections explain why the soul is at first unintelligent, and remains so afterwards'.

44 b 1–2. ὅταν . . . ῥεῦμα. This period, when we have attained a balance between waste and repair in the organism, is what is technically called the beginning of our ἀκμή. The ἀκμή lasts until the age at which waste begins to outrun repair. The beginning of ἀκμή is given in the *Republic* (ii. 460 e 1) as 30 for men and 20 for women, and the regulations in the *Laws* (721 b 6 ff., 785 b) about the proper age at which to marry show that Plato regarded the estimate as roughly correct. In the well-known verses on the ten 'ages of man', Solon (Hiller-Crusius 27) reckons growth complete by the end of the fourth 'seven years', and gives the fifth as the proper age for marriage.[1] We are on more definitely Pythagorean ground in the statements of Proclus (*In Alcib. I*, p. 196 Creuzer) that our ἀκμή falls in our fourth period of seven years, and of Macrobius (*In Somn. Scip.* i, vi) that the age of 28 is that at which a man reaches his full breadth, and that the time of full vigour lasts for the seven years from 28 to 35, i. e. these seven years constitute our ἀκμή.[2] (According to Macrobius there is no sensible decline up to 42, but after that age decline sets in, though slowly for the next seven years; afterwards it is accelerated until we reach the *meta vitae* at 70.) Timaeus may not have all these details in his mind, but he certainly means to include the troubled period of adolescence in the time before we begin to escape the consequences of 'incarnation'. The diminution of the αὔξης καὶ τροφῆς ῥεῦμα is thought of as not reached until we have attained full physical maturity, until the τροφή has outrun waste, though at a steadily declining pace. When physical maturity has been reached, the 'circles' begin of themselves to 'settle down' to their correct movements

[1] Τῇ δὲ τετάρτῃ πᾶς τις ἐν ἑβδομάδι μέγ' ἄριστος
ἰσχύν, ἣν τ' ἄνδρες σήματ' ἔχουσ' ἀρετῆς·
πέμπτῃ δ' ὥριον ἄνδρα γάμου μεμνημένον εἶναι
καὶ παίδων ζητεῖν εἰσοπίσω γενεήν.

[2] Cf the statement in the excerpt from Nicomachus of Gerasa in *Theologumena Arithmetica* (Ast) p. 49 τῇ δὲ τετάρτῃ τὴν ἐπὶ πλάτος τελειοῦται, καὶ οὐδεμία ἄλλη αὐτοῖς ἀπολείπεται σώματος ἐπίδοσις· τέλειος γὰρ ὁ κή', τῇ δὲ ε' κατὰ τὸν ἁρμονικὸν ἀποδειχθέντα τὸν λε' καὶ ἡ κατὰ ἰσχὺν πᾶσα ἐπίδοσις ἀποσφραγίζεται. (The remark about the number 35 means, as has already been explained (*op. cit.* p. 44), that 36 = 6 + 8 + 9 + 12, and this series corresponds to the fundamental notes of the διὰ πασῶν, ground-tone, fourth, fifth, octave.)

and a man begins to be ἔμφρων, 'sane', as opposed to ἄφρων, 'beside himself'. (The word must not be rendered 'wise; it is precisely the French *sage*.) The man who has come to maturity is so far merely not (like the adolescent) more or less 'crazy'. If he is to become 'wise' παίδευσις is further necessary.

44 b 8. ἂν μὲν οὖν. . . παιδεύσεως. St. is certainly right here about the grammar. παιδεύσεως depends on συνεπιλαμβάνηται, not on τροφή. 'If right nurture is seconded by education.' Two things are necessary if a man is to attain virtue and wisdom. (1) The man must get 'right nurture' from the first, and this is to be understood in the most literal sense. He must be *fed* properly and his body must grow up in the right way. It is for the same reason that Plato starts the great discussion of education in the *Laws* (vii. 788 a ff.) by demanding that even before a child is born its mother's diet and exercise shall be properly regulated, and that as soon as it is born the first care shall be given to see that it grows ὀρθόν, 'straight-limbed' and goes on to devote so much space to discussing the exercise and games of small children. (Apparently the very word *orthopaedics* comes from *Laws* 788 d 1, where it is said that σώματα . . . ὡς ὀρθότατα δεῖ νέων ὄντων εὐθὺς φύεσθαι τῶν παίδων.) The Pythagoreans were medical men as well as mathematicians, and as such would be fully alive to the importance for character of the *corpus sanum*. The later tradition was that the society attached the highest importance to diet and exercise, and made the ἐπιμέλεια σώματος a prominent part of the day's duty. (Iamblich. *V. P.* 97 μετὰ δὲ τὴν τοιαύτην διατριβὴν ἐπὶ τὴν τῶν σωμάτων ἐτρέποντο θεραπείαν. He goes on to describe the exercises and diet employed.) Since Aristoxenus (reproduced in Iamblich. *V. P.* 211–12) related the rules laid down to ensure the procreation of sound and healthy offspring, we may be sure that the proper feeding and training of the children, when born, was not neglected. Later on, we shall see that Timaeus himself regards bad bodily condition, inherited or derived from improper τροφή, as a chief source of moral defects. (2) And παίδευσις must then come to the aid of ὀρθὴ τροφή. In the section on 'disease of the soul' (86 b 1—87 b 9) we are expressly told that the two means of avoiding badness are correct τροφή on the one hand, and moral and intellectual education on the other (προθυμητέον . . . καὶ διὰ τροφῆς καὶ δι' ἐπιτηδευμάτων μαθημάτων τε φυγεῖν μὲν κακίαν, τοὐναντίον δὲ ἑλεῖν, 87 b 6–8). These words should make it impossible to go wrong about the construction and meaning of the present passage. Proclus gave the perfectly correct interpretation συνάπτει δὲ ταύτῃ (the influence of advancing years themselves) καὶ τὴν πολιτικὴν ἀγωγὴν τελεσιουργὸν οὖσαν τῆς φυσικῆς ἐπιτηδειότητος καὶ διὰ μὲν τῆς τροφῆς τῆς ὀρθῆς συνεθισμὸν τῷ ἀλόγῳ τῶν ἀγαθῶν πράξεων παρεχομένην καὶ τὴν κατὰ ὀρθὴν δόξαν ζωήν, διὰ δὲ τῆς παιδεύσεως μαθήμασι καὶ τῇ διαλεκτικῇ τὴν λογικὴν οὐσίαν τρέφουσαν.

44 c 1. ὁλόκληρος ὑγιής τε, c 3 ἀτελὴς καὶ ἀνόητος. Timaeus is here playing on words. The word ὁλόκληρος was used of animals which are fully furnished with all their proper complement of parts, as opposed to κολοβός, 'docked', 'defective'. Cf. Aristot. *Hist. Animal.* 585^{b} 35 ὀλίγα μὲν οὖν γίνεται τὰ τοιαῦτα, τὰ δὲ πλεῖστα γίνεται ὁλόκληρα ἐκ κολο-

βῶν (i.e. mutilations are not as a rule transmitted to offspring). So, more generally, we find ὁλόκληρος, 'whole and sound', contrasted with ἀσθενής, 'sickly', *Ethica Eudemia* Θ. 1248^{b} 32 οὐδ' ὁ κάμνων τῇ τοῦ ὑγιαίνοντος τροφῇ χρώμενος οὐδ' ὁ ἀσθενὴς καὶ ἀνάπηρος τοῖς τοῦ ὑγιοῦς καὶ τοῖς τοῦ ὁλοκλήρου κόσμοις. So at *Laws* vi. 759 c 1 Plato lays it down that persons selected for priesthoods must be 'whole and perfect' in their members and of legitimate birth; δοκιμάζειν δὲ τὸν ἀεὶ λαγχάνοντα πρῶτον μὲν ὁλόκληρον καὶ γνησίον. In this sense the word is about synonymous with τέλειος and ὑγιής. The use of the words χωλός, 'lamed', 'halt', and ἀτελής, 'imperfect', below to describe the man who never attains true wisdom shows that Timaeus has this sense of the word in his mind. But ὁλόκληρος appears also to have been a technical word in the language of the 'mysteries' to describe the completely initiated. This is the point of the passage in the *Phaedrus* 250 b 8 ff. τῶν τελετῶν ἣν θέμις λέγειν μακαριωτάτην, ἣν ὠργιάζομεν ὁλόκληροι μὲν αὐτοὶ ὄντες . . . ὁλόκληρα δὲ καὶ ἁπλᾶ καὶ ἀτρεμῆ καὶ εὐδαίμονα φάσματα μυούμενοί τε καὶ ἐποπτεύοντες ἐν αὐγῇ καθαρᾷ. Cf. [Olympiodor.] *in Phaedon.* ed. Norvin. p. 120 γίνονται βάκχοι, ὅ ἐστιν ὁλόκληροι κατὰ τὸν ἄνω μένοντα Διόνυσον. So ἀτελής is meant to suggest 'uninitiated in the τελεταί' as well as 'mutilated', and to allude to the Orphic doctrine that the 'uninitiated' suffer in Hades for their neglect of the 'mysteries'. The two ideas of 'halt and maimed' and 'without the sacraments' are meant to be combined.

44 c 1. τὴν μεγίστην ἀποφυγὼν νόσον. There is possibly an allusion to the formula used in the mysteries, ἔφυγον κακόν, εὗρον ἄμεινον, Demosthenes *de Corona* 259 (cf. Euripides *Bacchae* 902 εὐδαίμων μὲν ὃς ἐκ θαλάσσας | ἔφυγε χεῖμα, λιμένα δ' ἔκιχεν).

44 c 2. τοῦ βίου . . . ζωήν. A mere periphrasis for τὸν βίον. The reason for the change of word from βίον to ζωήν is simply that in *Attic* βίος is the normal verbal noun to ζῆν, so that 'to live one's life' is ζῆν βίον, and therefore 'the living of one's life' is βίου ζωή. In Ionic, on the other hand, βιῶναι ζωήν would be the regular expression. ζωή means simply vitality, being alive. A plant has ζωή, there is 'life' in it, but plants were not *usually* supposed to have 'consciousness'.

44 c 4. ὕστερά ποτε γίγνεται, 'happens later'. It happens after the death of the man in question, and at the present point in the story the first generation has not even been born. A.-H.'s note ignores the presence of the ποτέ. What 'happens later' is being contrasted with τὰ νῦν προτεθέντα, 'the topic *now* in hand', viz. the condition into which the ψυχή is thrown on its introduction into the body. The τὰ πρὸ τούτων of c 5–6, the 'preliminaries' to the conjunction of soul and body, are the special inquiries about the detailed structure of the 'parts' of soul and body respectively. The grammatical *ordo* in c 6 is περὶ τῆς κατὰ μέρη γενέσεως σωμάτων καὶ περὶ (τῆς κατὰ μέρη γενέσεως) ψυχῆς, 'about the piecemeal fashioning of body and of soul'.

44 d 1. τοῦ μάλιστα εἰκότος ἀντεχομένοις. The warning that our hypotheses are at best provisional is repeated because we are entering on a new subdivision of the discourse, the special details of sense-physiology and psychology. The caution is regularly renewed at the

leading transitions of this kind. (The commentary of Proclus, as we have it, ends here.)

44 d 3—45 a 2. **Τὰς μὲν δὴ . . . ἡμῶν.** The two 'circles' are now placed in the head, which is appropriately for the purpose given a spherical shape. For convenience of locomotion and as a support the head is then furnished with a trunk, arms and legs. The sphericity of the head helps to keep up the correspondence between the 'macrocosm' and the 'microcosm'. (Any other shape will involve deformation of the 'circles'.)

44 d 5. **ὃ θειότατόν τέ ἐστιν.** Timaeus follows Alcmaeon and agrees with the medical school of Cos in regarding the brain as the centre of the sensori-motor system. Alcmaeon is reported to have based his doctrine on the observation that dissection directly establishes the communication of the olfactory πόροι, 'passages', with the brain; whether these πόροι actually mean the olfactory 'nerve' is not quite clear. *Placita* iv. 17. 1 (*Doxogr.* 407 = *Fr. d. Vors.*[3] i. 133) Ἀλκμαίων ἐν τῷ ἐγκεφάλῳ εἶναι τὸ ἡγεμονικόν· τούτῳ οὖν ὀσφραίνεσθαι ἕλκοντι διὰ τῶν ἀναπνοῶν ('vents') τὰς ὀσμάς. According to Chalcidius (*Comment.* § 246, p. 279 Wrobel). A. detected the optic nerves and 'chiasmus' by dissection, though Aristotle's allusion to the same matter, *de Generat. Animal.* B. 744[a] 8, which speaks of 'passages' (πόροι) leading from the eyes to 'the membrane round the brain', suggests the possibility that the πόροι of early physiologists may after all be blood-vessels. The doxographical reports show that Alcmaeon believed the 'passages' he had discovered to be full of πνεῦμα, 'animal spirits', so that his theory of sensation is really on the same lines as that of Descartes. In later times, Galen followed Alcmaeon and Timaeus, whereas Aristotle and the Stoics insisted that the heart is the central 'sensorium', and the authority of Aristotle made this the prevailing view all through the Middle Ages down to the dawn of the seventeenth century. It is expressly taught in the middle of that century by Hobbes, and Galileo has a story of an Italian Aristotelian who refused to be convinced by an actual dissection, remarking that 'if it were not for the express statements of Aristotle on the other side', he would have been persuaded to believe his own eyes. Further comment may be deferred until we come to what Timaeus has himself to say about the exact constitution and functions of the brain. The head, then, is the one part of the body which is intrinsically important. The trunk and limbs exist only because it would be inconvenient if the head had to get about by rolling on the earth's surface, which is so very uneven. On an earth as level as a good cricket-pitch this would not matter so much, but a head without a body might be unable to roll up a steep hill or might get 'bunkered' in a pit. Of course we must recognize that Timaeus is indulging in a little playful banter. There is 'a good deal of fun' in him as Lamb said there was in Coleridge, and he is by no means as solemn in a passage like this as he looks to a dull person to be. We can even identify the person against whom the banter is directed. It is Empedocles; Timaeus has a very great respect for him, but is quite ready to 'chaff' him on occasion. The obvious allusion is to Empedocles' account of the evolution of living beings when Love was gradually

banishing Strife, when, as he says (Fr. 57 = R. P. 173 a) 'many a head sprang up without a neck, arms wandered about without shoulders, and eyes without foreheads' (ᾗ [Diels ᾗ] πολλαὶ μὲν κόρσαι ἀναύχενες ἐβλάστησαν, | γυμνοὶ δ' ἐπλάζοντο βραχίονες εὔνιδες ὤμων, | ὄμματά τ' οἰ ἐπλανᾶτο πενητεύοντα μετώπων). That would be very awkward for the heads, and we may be sure that no such state of things was ever allowed to exist in a 'good' world. The passage would be pointless but for the humorous polemic against the lines of Empedocles.

44 e 4. πορείαν. The word means 'method of getting about', manner of locomotion, Lat. *incessus*. This is just the sense we need, 'God contriving a *gait*, a way of getting about, for it'. The πορεῖα of some inferior MSS. would mean 'carriages', but it is perilously like nonsense to talk of one being as riding in several carriages at once.

45 a 2. προσέφυ. The singular verb is an imitation of poetic style. Cf. Kühner-Gerth iii. 68 'The substantives with which the construction is found are names of things which were perhaps conceived in the same fashion as neuter plurals' (i. e. as equivalent to feminine collective singulars, the -α of the neuter plural having apparently originated in this way). The grammars give an example or two from the poets, e. g. Pindar *Ol.* xi. 4 μελιγάρυες ὕμνοι ὑστέρων ἀρχαὶ λόγων τέλλεται. The construction is sometimes called the σχῆμα Βοιωτικόν or Πινδαρικόν. In prose the construction is probably only apparent, since (except here) it seems only to occur with ἐστί, ἦν, γίγνεται (and of these ἦν is not a singular at all but a regularly formed plural with the ending -ν for -ντ, like e. g. ἔβαν *Ol.* ii. 64), and the verb comes first, being, in fact, impersonal. (So we say, 'it *is* ten years since, etc.', 'it *was* a lover and his lass'.) There is one example—quoted by A.-H.—in Plato *Symposium* 188 b with γίγνεται coming *last*, but no real parallel to the violence of the expression used here. It is meant to be dithyrambic and 'mock-heroic', and is a sign that Timaeus is really speaking 'in fun'.

45 a 3–b 4. τοῦ δ' ὄπισθεν . . . αἰτίᾳ. As we were made to walk forwards and not backwards, our faces were placed in front and eyes put in them that we may see our way. I. e. simply we were made to face in the direction in which we habitually walk. The underlying fancy that one member of each of the pairs πρόσω—ὀπίσω, δεξιόν—ἀριστερόν, ἄνω—κάτω is the 'more honourable' was taken seriously by the early Pythagoreans, as we see from the fact that τὸ δεξιόν appears on the same side as the One and the Good, τὸ ἀριστερόν on the same side as the Many and the Bad in their well-known table of 'opposites'.

45 a 4. τὸ πολὺ τῆς πορείας. τὸ πολύ because we *can* move backwards, though we only do so exceptionally, and young children beginning to creep go backwards as well as forwards.

45 b 2—46 a 2. *The structure and working of the eye.* The essential organ of vision is a stream of fine fire of the same kind as sunlight. In vision this stream issues from the eye, and fuses with the light around us. The 'visual ray' thus formed is a temporary organ of the body, and sight is due to contact of it with external objects. At night there is no external sunlight, and the fusion is impossible. This is why we do not see in the dark. Further, at night, the fire which would, if it could,

make its way out through the passages of the eye, is turned back upon the interior of the organism, 'equalizes' the motions going on there, and so induces sleep.

45 b 4–6. τοῦ πυρὸς . . . γίγνεσθαι. The thought is the same which lies at the bottom of the famous parallel between vision and knowledge, the sun and the Form of Good, in the sixth book of the *Republic*. There is actual sunlight in the eye itself, and this sunlight is what we see with, the actual 'organ of vision'. (*Rep.* vi. 508 b 3 ἡλιοειδέστατον . . . τῶν περὶ τὰς αἰσθήσεις ὀργάνων, Aristoph. *Thesmophor.* 17 ὀφθαλμόν, ἀντίμιμον ἡλίου τροχῷ.) As for the construction, σῶμα is a 'tertiary predicate' with ἐμηχανήσαντο γίγνεσθαι. The gods made 'such fire as had the property not of burning, but of providing a gentle light, proper to day'—i. e. light, as opposed to gross flame—'into a body'. That is, they collected dispersed 'light' into a mass with a local habitation and a name. A.-H. has been led astray by Madvig into taking οἰκεῖον ἑκάστης ἡμέρας, which really qualifies φῶς, with σῶμα, so as to get the sense that the gods made the fire which does not burn but gives light into a 'body appropriate to daylight'. This, however, cannot be right. All fire is already a body, and the fire which gives light but does not burn *is* sunlight.

45 b 6–c 2. Here again we have to avoid a curious mistake which has been made about the grammar of the sentence. λεῖον καὶ πυκνόν do not go with ῥεῖν but qualify the following words ὅλον and τὸ μέσον, as C. W. carefully explains. It would be well to indicate this by placing a comma after ῥεῖν. 'They made the fire within us which is akin to this (i. e. to sunlight) flow in a fine stream through the eyes, having first compacted the whole, and more particularly the middle of the eye so as to be smooth and dense.' This must be what is meant, since (*a*) πυκνόν, 'dense', would have no satisfactory sense if supposed to be said of the fine 'fire' in the eye, which is not πυκνόν but μανόν, 'rare', of fine consistency', and (*z*) the next clause excludes all possibility of referring πυκνόν to anything but the structure of the eye, 'so that it kept in everything of grosser texture and let this fire filter through pure by itself'. It is precisely the fact that the eye was made so πυκνόν that explains why nothing less subtle than the supposed sunlight can escape through it. Timaeus is referring to the smoothness and hardness of the *cornea*, and he is saying that it has these qualities expressly that it may let through nothing but the rays of light he has already mentioned. None of the other contents of the eye, e. g. the 'aqueous' or 'vitreous' humours, can get through the cornea. The cornea is thus exactly like the horn (or glass) of a lantern, with which Empedocles expressly compared it. We shall see directly that T.'s whole theory of vision is based on that of his eminent contemporary, as it is natural it should be. The central thought of both theories is that 'like is perceived by like'; therefore it must be by 'light' within us that we see light around us.

45 c 2–d 6. ὅταν οὖν . . . οὐκ ἔχοντι. The general theory of the process, then, is this. In the daytime, the fine light within the eye can get out in a stream, and then fuses with the light round about it. (This may be either the sunlight reflected from surfaces, or, in the case of self-luminous objects—and we shall see, later on, that Timaeus regards all

coloured things as in some degree self-luminous—the 'proper light' of the self-luminous body.) In this way there arises a 'pencil' of light extending from a body outside us continuously to our own eye, and this pencil is a temporary, but real, member of our body and is sensitive throughout, and so 'transmits' sensation from one extremity to the other. Light is thus a kind of extended touch or contact at a distance. E. g. what happens when I see a mountain ten miles away is this. The light issuing from my eye has for the time been fused into one homogeneous body with light 'reflected' from the mountain. This temporary ten-mile long extension of my body is 'like', homogeneous throughout, and therefore the sensation due to its contact with the mountain is transmitted along its whole length (this is the point of *ὁμοιοπαθὲς δὴ δι' ὁμοιότητα πᾶν γενόμενον*), from the mountain at one end to my organism at the other. So it reaches my *ψυχή* through my organism and I 'see'. It is briefly summarized by Plutarch *Quaest. Conviv.* i. 8. 4, 626 c, d, where the main position is fairly accurately given thus: *πνεῦμα τῶν ὀμμάτων αὐγοειδὲς ἐκπῖπτον ἀνακίρναται τῷ περὶ τὰ σώματα φωτί, καὶ λαμβάνει σύμπηξιν, ὥσθ' ἓν ἐξ ἀμφοῖν σῶμα δι' ὅλου συμπαθὲς γενέσθαι. κεράννυται δ' ἕτερον ἑτέρῳ συμμετρίας τε λόγῳ καὶ ποσότητος· οὐ γὰρ ἀναιρεθῆναι δεῖ θάτερον ὑπὸ θατέρου κρατηθέν, ἀλλ' ἀπ' ἀμφοῖν ἕς τι μέσον ἁρμονίᾳ καὶ κοινωνίᾳ συναχθέντων μίαν δύναμιν ἀποτελεσθῆναι.* (The substitution of *πνεῦμα αὐγοειδές* in this version for the *πῦρ* of Timaeus himself is a Stoicizing touch.) In the dark things happen differently. The fire issuing out from the eye finds no corresponding light with which it can fuse. It is 'isolated' (*ἀποτέτμηται*) at the exit from the eye because its 'kindred fire has vanished into the dark'. If it gets out at all, it comes into contact with a thing of a 'foreign' kind (*πρὸς ἀνόμοιον*) and so 'changes its own being' and is 'put out'. (The *συμφυές* of d 5 must be taken quite literally. In the dark there is nothing outside with which the visual fire could grow into one body; and observe, as a subtle touch, the *ἀήρ* apparently means, not what it did in Plato's own day, atmospheric air, but what the word means in early literature from Homer onwards, and often enough in Empedocles himself, mist or water-vapour. The darkness is supposed to be a damp mist and therefore naturally 'puts out' (*κατασβέννυσι*) any fire from the eye which may come in contact with it. The confusion of air with mist was, of course, a thing of the long distant past when Plato wrote this dialogue. But Empedocles himself was the first man to distinguish the two things, and Timaeus is his contemporary. It is therefore a correct bit of historical colouring that though both knew quite well that darkness is the shadow of the earth and that air and mist are different things, both should more than once *speak* as men had always spoken.

Aristotle criticizes the theory of Empedocles and Timaeus (he treats their views as identical[1]), in c 2 of his little essay *de Sensu* (437[b] 11 ff.) If we see by a flame which streams through the eye as the light does through the horn of a lantern, why cannot we see in the dark? I. e. why should we *not* be sensitive in the dark to the contact of the supposed

[1] loc. cit. *καθάπερ Ἐμπεδοκλῆς φησὶ καὶ ἐν τῷ Τιμαίῳ γέγραπται.*

'visual ray' with an object, just as much as to the contact of hand or foot with one? 'to say, that the flame is 'put out' in the dark is idle (*τὸ δ' ἀποσβέννυσθαι φάναι ἐν τῷ σκότει ἐξιοῦσαν, ὥσπερ ὁ Τίμαιος λέγει, κενόν ἐστι παντελῶς*, ib. d. 14–15). How can *light* be 'put out'? What is hot and dry is 'put out' by moisture or cold, as is held to be the case with fire in embers and with flame (*φλόξ*), but neither case seems to arise in connexion with *light*. If you mean that the case does occur, but we do not notice it because the process is gradual (*διὰ τὸ ῥέμα*), light ought to be 'put out' in the daytime in rainy weather (*ἐν τῷ ὕδατι*),[1] and again it ought to be unusually dark in frosty weather. At any rate this is what happens to flame and to bodies set on fire. But in fact nothing of the kind occurs (in the case of light) (loc. cit. 437^{b} 15–23). A.-H. quotes some of this criticism but seems to miss its main point. Aristotle held that light is not the same thing as flame or fire, and, in fact, is not a body at all. What he is really urging against Empedocles and Timaeus is that if light were a kind of flame it ought not to be able to traverse water, as it does, and it ought to be affected by the cold, though a very cold, frosty day, as a fact, may be a bright one. The heat of a body is always lowered by surrounding cold. Why then are not cold, frosty days always exceptionally dark, if light is a 'fire' or 'flame' of some kind? And why is the 'flame' which is supposed to be the 'organ' of vision not put out on wet and frosty days, as a fire is put out if you throw water on it or overload it with cold bodies? Now that we have all read of the 'weighing of light', it may seem more reasonable to us than it did either to Aristotle or to our own fathers to think of light as a kind of body, but Aristotle's argument against the explanation given by Timaeus of our inability to see in the dark is none the less a good *argumentum ad hominem*. His own very different view was that not fire but water is the 'predominant element' in the eye, and that the theory that we see by a visual ray issuing from the eye is a mistaken inference from the familiar fact that fire seems to flash from the eyeball when it is struck or pressed. The eye in this case is falsely imagined to be actually seeing itself. But if the eye can really see itself, why does it not see itself when it is left at rest? *de Sensu* 437^{a} 22–9 *ποιοῦσι δὲ πάντες τὴν ὄψιν πυρὸς διὰ τὸ πάθους τινὸς ἀγνοεῖν τὴν αἰτίαν· θλιβομένου γὰρ καὶ κινουμένου τοῦ ὀφθαλμοῦ φαίνεται πῦρ ἐκλάμπειν· τοῦτο δ' ἐν τῷ σκότει πέφυκε συμβαίνειν, ἢ τῶν βλεφάρων ἐπικεκαλυμμένων· γίνεται γὰρ καὶ τότε σκότος· ἔχει δ' ἀπορίαν τοῦτο καὶ ἑτέραν. εἰ γὰρ μὴ ἔστι λανθάνειν αἰσθανόμενον καὶ ὁρῶντα ὁρώμενόν τι, ἀνάγκη ἄρ' αὐτὸν ἑαυτὸν ὁρᾶν τὸν ὀφθαλμόν. διὰ τί οὖν ἠρεμοῦντι τοῦτ' οὐ συμβαίνει.* We should compare the version of the matter given by Timaeus with Empedocles' own statement of it. The verses in which he illustrated vision by comparison with the case of a lantern are quoted in full by Aristotle (*de Sensu* 437^{b} 23 = R. P. 177 e, Emped. Fr. 84 Diels). 'Even as when a man, thinking to sally

[1] I have followed the sense put on *ἐν τῷ ὕδατι* by Prof. Beare in the Oxford translation of the *Parva Naturalia*. But must not the point be rather that on the theory in question water ought never to be transparent, since it should 'put out' the visual ray? Would not 'in rainy weather' be *ἐν ὕδασι* rather than *ἐν τῷ ὕδατι*? The argument would be that all water should be opaque, as deep sea water is.

forth through a stormy night, gets ready a lantern, a flame of blazing fire, fastening to it horn plates to keep out all manner of winds, and they scatter the blasts of the winds that blow, but the light leaping forth, as much of it as is fine and thin (*ὅσον ταναώτερον ἦεν*), shines across the threshold with unfailing beams, even so did Love entrap the elemental fire (*ὠγύγιον πῦρ*), the round pupil, confined within membranes and delicate tissues, which are pierced through and through with wondrous passages. They keep out (?) the deep water that surrounds the pupil, but they let through the fire, as much of it as is finer.[1] The general theory is exactly that of Timaeus ; and we have the same point about the cornea being so constructed that it lets the 'thin' flame stream out but not the 'humours' which surround it. Thus it seems to me that Plato definitely means to represent Timaeus as teaching the views of Empedocles about vision and that Aristotle is justified in coupling the two names. A.-H. has an attempt to show that what he calls 'Plato's theory' differs on an important point from that of Empedocles. Empedocles held that sensations are caused by 'effluences' (*ἀπόρροιαι*) from things fitting into the 'passages' (*πόροι*) of our sense-organs, and Theophrastus (*de Sensu* 7 = R. P. 177 b) says that he employed the theory to explain colour-vision, holding e. g. that the effluences from white things fit into the passages in the fire in the eye, those from black things into the passages in the watery parts of the eye (*τοῖς μὲν τοῦ πυρὸς τὰ λευκά, τοῖς δὲ τοῦ ὕδατος τὰ μέλανα γνωρίζειν· ἐναρμόττειν γὰρ ἑκατέροις ἑκάτερα. φέρεσθαι δὲ τὰ χρώματα πρὸς τὴν ὄψιν διὰ τὴν ἀπορροήν*). It is true that Timaeus does not say anything here about these *πόροι*. But this is because he is not at the moment offering an account of *colour*-vision at all. When we come to his account of colour and colour-vision, we shall find that this feature of Empedocles' sense-physiology is carefully reproduced. (See 67 c 6 where colour is explained as *φλόγα τῶν σωμάτων ἑκάστων ἀπορρέουσαν, ὄψει σύμμετρα μόρια ἔχουσαν πρὸς αἴσθησιν.*) So the 'effluences' are ultimately in Timaeus' account too, and they are there for the very same purpose for which Empedocles employed them.[2] The simple fact is that Empedocles appears to have said things about vision which, at first sight, are not quite consistent. He gave a *general* theory of visual sensation in which it was explained by means of the 'visual ray' issuing from the eye; when he came to deal with colour in particular he brought in the 'effluences'. This is why Aristotle in the passage where he quotes Empedocles' lines about the lantern remarks that Empedocles sometimes seems to think that we see by a ray of light issuing from the eye, some-

[1] I borrow Prof. Burnet's rendering (*EGPh.*[3] 217). The text presupposed differs from that in R. P. and *Fr. d. Vors.*[3] in removing the comma after *ἄψας* in the third line of the fragment. In l. 7 Bt. rightly, I think, supposes that 'Love' is the subject to *λοχάζετο*, and in the last line translates *διίεσκον* (the word given in the Aristotelian MSS. for the *διαθρῷσκον* of Bekker kept by R. P.). I think, however, *ἐπέστεγον* in the last line but one means 'keep *in*', not 'keep *out*', as I take the meaning to be that the 'membranes' let the fire stream out through the eye, as Timaeus says, *μόνον αὐτὸ καθαρόν*.

[2] It is said at *Meno* 76 d that it is a definition of colour *κατὰ Γοργίαν* to call it *ἀπορροὴ σχημάτων ὄψει σύμμετρος καὶ αἰσθητός*. This agrees exactly with what Timaeus says at *Tim.* 67 c, and what Theophrastus relates of Empedocles, and Gorgias is said, on the authority of his pupil Alcidamas, to have been a disciple of Empedocles.

times that we see because of effluences from things which fit into the 'passages' in the eye (*de Sensu* 438[a] 4 *ὁτὲ μὲν οὕτως ὁρᾶν φησίν, ὁτὲ δὲ ταῖς ἀπορροίαις ταῖς ἀπὸ τῶν ὁρωμένων*). It is not clear to me that there is any real inconsistency at all, and Timaeus, as we have seen, reproduces both parts of the theory, each in its proper place. Hence it seems to me plain that Plato is deliberately ascribing to him the theory of Empedocles. Whether Plato himself personally accepted this or any other theory of vision the dialogues do not enable us to determine. There is no special reason why he should not have thought Empedocles' account the best that had yet been given, but the mere fact that he attributes it to Timaeus proves nothing. In any case A.-H. probably makes a mistake in confounding the theory of Empedocles about 'effluences' with that of Democritus. What Empedocles supposed the 'effluences' to be made of does not appear except from the words just quoted from *Timaeus* 67 c. Timaeus there expressly calls them 'flame', and it is reasonable to suppose that he is reproducing Empedocles. In any case, Empedocles seems to have supposed his 'effluences' to be minute particles from the actual substance of the perceived body. Democritus, on the other hand, as appears from the long discussion of his views in Theophrastus *de Sensu* 49–83 (*Doxogr.* 513 ff., *Fr. d. Vors.*[3] ii. 1. 40–8) definitely said, in the case of sight at any rate, that what is transmitted to the organ of sense is a mould or print *impressed on the surrounding air or water* by the object (an *ἀποτύπωμα*), and further explained that this 'mould' gives rise to sight by being 'reflected in the pupil'. Theophrastus found this statement perplexing; he asks reasonably why if there is an *ἀπορροή* at all, the *ἀποτύπωμα* should be brought into the account, since it would be more natural to suppose that we see the *ἀπορροή* itself (*ὅλως δὲ ἀπορροὴν ποιοῦντα τῆς μορφῆς ὥσπερ ἐν τοῖς περὶ τῶν εἰδῶν, τί δεῖ τὴν ἀποτύπωσιν ποιεῖν; αὐτὰ γὰρ ἐμφαίνεται τὰ εἴδωλα*). This means that Democritus is combining two theories, one of which must be superfluous. He speaks of 'effluences' from objects and yet supposes that what we actually see is not the 'effluences' themselves but 'prints' made by them on the air or water between the eye and the object. (Apparently this second part of the statement was meant to explain distortion of the apparent size and shape of the object by the intervening medium).[1] It does not seem to me possible to make the other statements of Democritus reported by Theophrastus fit in with this theory. In the case of tastes it is very hard not to suppose that he conceived of actual 'atoms' of the sapid body as entering the *πόροι* of the tongue and the same thing seems to be implied in his attempt to connect three of his 'primary' colours, white, black, red, with the shape and size of the 'atoms'. Possibly the *ἀποτύπωσις* was only appealed to in the case of sight because it is by sight that we apprehend things at a distance, and

[1] Theophrastus *de Sensu* 50 (*Doxogr.* 513, *Fr. d. Vors.*[3] ii. 1. 40) *ὁρᾶν μὲν οὖν ποιεῖ τῇ ἐμφάσει· ταύτην δὲ ἰδίως λέγει· τὴν γὰρ ἔμφασιν οὐκ εὐθὺς ἐν τῇ κόρῃ γίνεσθαι, ἀλλὰ τὸν ἀέρα τὸν μεταξὺ τῆς ὄψεως καὶ τοῦ ὁρωμένου τυποῦσθαι συστελλόμενον ὑπὸ τοῦ ὁρωμένου καὶ τοῦ ὁρῶντος.* ib. 53 (*Doxogr.* 514, *Fr. d. Vors.*[3] ii. 1. 41) *ἀνάγκη γὰρ ἐξ ὧν λέγει πάντα ἐναποτυποῦσθαι τὰ σώματα καὶ πολλὰ ἐναλλάττειν, ὃ καὶ πρὸς τὴν ὄψιν ἐμπόδιον ἂν εἴη καὶ ἄλλως οὐκ εὐλόγον.*

the problem about the effect of the medium in distorting the appearances has therefore to be faced. But the account of sight at any rate differs from that of Timaeus and Empedocles by bringing in the 'impression' on the medium and also by making the 'reflection in the pupil' play a part in the process. This presumably indicates the influence of Anaxagoras, who also had said that we see 'by the reflection on the pupil'.[1]

It seems possible that the theory of Empedocles itself is an elaboration of something still earlier, which goes back to Alcmaeon. For Theophrastus gives the following account of Alcmaeon's views (*de Sensu* 26, *Doxogr.* 506–7, *Fr. d. Vors.*[3] i. 132): *ὀφθαλμοὺς δὲ ὁρᾶν διὰ τοῦ πέριξ ὕδατος. ὅτι δ' ἔχει πῦρ δῆλον εἶναι· πληγέντος γὰρ ἐκλάμπειν. ὁρᾶν δὲ τῷ στίλβοντι καὶ τῷ διαφανεῖ, ὅταν ἀντιφαίνῃ, καὶ ὅσον ἂν καθαρώτερον ᾖ, μᾶλλον.* There are several ambiguities about this statement, but it is clear that the 'fire in the eye' is regarded as the agent in vision. The reference to the *πέριξ ὕδωρ* is a little perplexing. It may mean the 'humours' in the eye which surround the 'fire' and are 'kept in' by the cornea. Or again the *ὕδωρ might* mean what we still call the 'atmosphere' surrounding our body. As for the statement that we see with *τὸ στίλβον* (the *καὶ διαφανεῖ* appears to be added by Theophrastus as his own explanation of Alcmaeon's words *τῷ στίλβοντι*) 'when it shines back, and the purer this *στίλβον*, the better our vision', I cannot help thinking that the *στίλβον* which 'shines back' is just the light all round our bodies, and that the theory is really at bottom just that of the union of the visual ray with the light outside. I do not think it very likely that Dr. G. M. Stratton is right in rendering the words 'the gleaming character of that ⟨which in the eye⟩ *reflects* the object'. If Alcmaeon had held the Anaxagorean view that we see 'by the reflection in the pupil', Theophrastus would have noted the point, and the 'fire in the eye' is superfluous in that type of theory of vision.[2]

45 d 6—46 a 2. παύεταί τε . . . φαντάσματα. A passing attempt to explain why we grow sleepy at nights and why we dream. When the eyelids, which Providence has designed as a protection for the eyes and the visual fire within them, close, the fire within can no longer make its way out; it is therefore turned back on itself and produces a 'diffused' and equalized state of motion within, i. e. it sets up a uniform condition of movement, much as the recoil of a wave would obliterate little local eddies. The effect of this suspension of 'differential motions' is to produce a state of monotony (*ἡσυχία*) and so to induce sleep. The more complete the tranquillization, the deeper and more dreamless the

[1] Theophrastus *de Sensu* 27 (*Doxogr.* 507, *Fr. d. Vors.*[3] i. 395, R.P. 161 e) *Ἀναξαγόρας δὲ γίνεσθαι μὲν τοῖς ἐναντίοις· τὸ γὰρ ὅμοιον ἀπαθὲς ὑπὸ τοῦ ὁμοίου, καθ' ἑκάστην δ' ἰδίᾳ πειρᾶται διαριθμεῖν. ὁρᾶν μὲν γὰρ τῇ ἐμφάσει τῆς κόρης.* Democritus' theory appears to be an attempt to fuse the Empedoclean view that like sees like with the Anaxagorean view that unlike sees unlike. Theophrastus complains (*de Sensu* 49, *Doxogr.* 513, *Fr. d. Vors.*[3] ii. 1. 40), that it is impossible to discover whether D. held the theory of perception by likes or that of perception by unlikes, and the account of vision seems to show that the complaint was deserved.

[2] For other views of Alcmaeon's meaning see G. M. Stratton *Greek Physiological Psychology* pp. 175–6, and Beare *Greek Theories of Elementary Cognition* 11–13.

sleep. If there are considerable 'differential' motions which are not wholly equalized out by the return of the stream of visual fire, we see corresponding images. The thought is that the actual exercise of vision sets up a variety of motions (primarily within the eye, but no doubt also in 'the nervous system' generally). If these are not wholly obliterated by the return of the visual fire, but 'vestiges' of them persist, we have corresponding 'images', so long as these motions persist and retain their form.

45 e 2. διαχεῖ, lit. 'disperses'. The word, in its various physical and physiological applications, is the standing antithesis to πηγνύναι to 'solidify'. The thought is pretty clearly that the movement of the introverted visual stream is like the recoil of a big wave which washes out lesser movements in its track. τὰς ἐντὸς κινήσεις. The explanation of dreams which follows shows that the κινήσεις referred to are, in the first instance, local motions of various kinds in the eye itself (in the 'retina', as we might say), but since, as we shall learn later on, sensation depends on stimulation of the brain, we have to think also of motions in the sensory *centres*, and we may fairly suppose all sorts of internal disturbances in the organism as a whole to be included. The general effect of the return of the fire in the eye is to tranquillize all these 'differential' movements.

45 e 5. ἐν οἷοις ἂν τόποις. The τόποι must be 'regions', in the first instance, of the eye itself, and secondarily of the 'sensory centres' where there are still 'differential' motions which have not been made completely uniform. The character of our dreams thus is made to depend on (1) the *form* of the remaining residual motions, (2) the regions of the body where they occur. It will depend e. g. on (1) whether I dream of seeing a man or a horse; an instance of (2) would be that 'residual movements' will give rise to a different type of dream according as they occur in the retina or in the viscera.

46 a 1–2. ἀφομοιωθέντα . . . ἀπομνημονευόμενα. Apparently the ἐντός must be taken with ἀφομοιωθέντα, the ἔξω with ἀπομνημονευόμενα. The images are formed 'within'. Strictly this ought to mean simply 'in the private world of dreams, which is accessible to no one but the individual dreamer'. But Timaeus is probably falling into a confusion which is common enough even to-day. He probably confuses the 'image' which I see in a dream with the 'motion' which is its stimulus. The stimulus being 'inside the body', he fancies that the figures of the dream are seen somewhere inside my body ('in my head') too. The images are the 'remembered outside' ἔξω, 'in the waking world' when the dream is over. I. e. the remembering of the dream belongs to the waking world, not to the dream world, because I have myself come back to the 'common world' when I wake up. What I know about my dreams is not the dreams themselves but my recollection of them after I have myself ceased to dream. (This is a true and important observation. Probably most of our dreams are 'rationalized' and made much more coherent in our waking recollections of them than they really were, a point forgotten by the persons who collect examples of remarkable 'veridical' dreams.) This interpretation seems the only one which can be got

out of the words of the Greek. C. W. points out that it is given correctly in A.-H.'s note, but a different and impossible sense is put on the words in his rendering—viz. that the dream is 'remembered as being without us'. Here the 'as being' cannot be extracted from the Greek, and if it could the sense would be a false one. It is not normal for us to suppose that what we dreamed last night 'happened in the real world'. Usually we take the dream for what it was, a dream. Stallbaum renders 'et extra nobis expergefactis in memoriam revocata', which is exactly correct. Martin makes a mistake of a different kind; he takes ἐντὸς ἔξω τε together with ἀφομοιωθέντα and interprets this to mean that the 'images' of the dreams may be either of *choses extérieures* or of *choses intérieures*. Grammatically this has the fault of treating τε as if it could be used to couple single words, and further 'images formed within and without' would be an impossible phrase for 'images of *things* within and of *things* without'.

The main point of T.'s theory about sleep is that it accounts for sleep by the effects of a monotonous uniformity in sensation in lowering the intensity of consciousness. There is an element of truth in this, and we act on this knowledge when we try to send ourselves to sleep by making the rhythm of consciousness monotonously uniform, by keeping the body recumbent and motionless, by darkening the room, and by devices like counting, or by trying to imagine sheep jumping a fence. We see the same thing in the employment of the concentration of attention on a fixed object to induce the hypnotic state. The precise theory of Timaeus about the return of the visual ray on itself does not seem to appear anywhere else, but our knowledge of fifth-century theories of the subject is very scanty. Empedocles is said to have given a different theory, that sleep is due to a lowering of the temperature of the blood; the result would be actual death if the lowering were carried far enough. Ἐμπεδοκλῆς τὸν μὲν ὕπνον κατάψυξιν τοῦ ἐν τῷ αἵματι θερμοῦ σύμμετρον γίνεσθαι, τὴν[1] δὲ παντελῆ θάνατον (*Placita* v. 24, *Doxogr.* 435). Alcmaeon, according to the same section of the *Placita*, taught that sleep is caused by a 'withdrawal' of the blood from the surface of the body. Aristotle's theory, expounded in the essay *de Somno et Vigilia*, is more elaborate. Sleep is required to make good the fatigue induced by continuous exercise of the sensory system. Its mechanical cause is change in the blood set up by the process of digestion. Nutriment taken into the blood evolves heat and evaporation. The 'vapours' thus engendered rise until they reach the brain where they are suddenly cooled, the brain being moist and cold. Consequently they are repelled downwards and this brings about the muscular relaxation and suspension of sensation characteristic of sleep. Aristotle thus anticipates two views which have been widely held in later times, (*a*) that the immediate cause of sleep is 'fatigue' of the 'highest centres' (though he places these centres in the heart, not in the brain), (*b*) that the fatigue is due to the temporary presence of 'toxic' substances in the blood. He then accounts for dreams as due to residual motions in the 'common' or central sensorium, i.e. the heart. These faint residual motions, arising from

[1] In *Fr. d. Vors.*[3] i. 216 Diels reads καταψύξει. . . τῇ δὲ παντελεῖ, a questionable change.

previous stimulation through the sense-organs, go on throughout waking life, but are not attended to when we are awake, because attention is then monopolized by the more insistent motions due to actual present excitement of the sense-organs.

46 a 2–c 6. τὸ δὲ περὶ . . . ἀπῶσαν. Timaeus now proceeds to give an explanation of the formation of images in mirrors and reflecting surfaces generally, and of the lateral displacements and inversions which occur according to the kind of mirror employed. Apparently the subject is suggested by the fact that he has just used the word *φαντάσματα*, 'images', for the figures we see in our dreams; as the word was also used of the 'unreal' appearances in reflecting surfaces as well as for those of dreams, he goes on to say something about this other class of *φαντάσματα*. He treats the matter at a curiously disproportionate length, but this will not surprise us when we remember how perplexing these appearances, particularly those in which the image is inverted or has its 'right' and 'left' exchanged, must have appeared to scientific students unacquainted with the simplest laws of optics. Theophrastus must have treated of the subject at some length, as there is a chapter on the subject in the *Placita* (iv. 14, *Doxogr.* 405) containing notices of the theories of Empedocles, Democritus (Epicurus), and the Pythagoreans. Timaeus states the facts about the appearances in the different kinds of mirrors he describes accurately, but, as Martin says, his explanations of the process of reflection in each case are faulty, because they all depend on his theory that we see by a ray of light emitted from the eye towards the object seen. See the convenient summary of the facts together with the correct optical explanations of them given by M. in his note on the present passage (*Études* n. 52, vol. ii. 163–71). It must be remembered that the curved reflecting surfaces commonly described in modern works are either spherical or parabolic, whereas the mirrors of the kind known to the ancients and described by Timaeus are cylindrical. The point of primary philosophical interest throughout the section is that Timaeus properly rejects the erroneous assumption that what we see when we look in the glass is an actual 'copy' or 'image' formed on or behind the surface of the mirror. He is clear on the point that what I see e.g. when I look in my shaving-glass is my 'actual' face, not a 'copy' of it, though I see it *indirectly*, by reflected light, and his object is to explain the laws of the reflection.[1]

46 a 3. πάντα is governed by *περί*. 'It will now be easy to explain the facts about the formation of images in mirrors and (the facts about) bright smooth surfaces in general.'

46 a 4–b 3. ἐκ γὰρ τῆς ἐντὸς . . . γιγνομένου. I think A.-H.'s interpretation of this wrong on two points. (1) He distinguishes between two 'coalescences', the coalescing of the fire issuing from the eye with the daylight outside and a further coalescing of the body thus formed with a ray from the external body seen. It is this second coalescence which

[1] Cf. Whitehead *Principles of Natural Knowledge* p. 85: 'Alciphron, in Berkeley's dialogue, sees a crimson cloud. Suppose that he had seen the cloud in a mirror. He would have "seen" crimson as situated in an event behind the mirror, but he would have "really seen" the cloud behind him.'

he supposes to take place, in the case of looking in the mirror, at the mirror's surface. Presumably he must hold that there is this double coalescence in all vision, but that in direct vision the second fusion takes place at the actual surface of the body we are looking at. I can find no trace in the language of Timaeus of any such double coalescence, and, as C. W. says, though the statement of the *Placita* (iv. 13. 11, *Doxogr.* 404) about Plato's theory of vision may be made to yield it, neither Aristotle nor Theophrastus ever refers to a double coalescence in criticizing the *Timaeus*. Hence I believe that the only coalescence supposed by Timaeus to take place at all in vision is between the 'fire from the eye' and fire outside, the latter being either the sunlight reflected from the body looked at, or, when that body is self-luminous, its own light. I think myself that the statement in the *Placita* really means this also, though it contains one statement which is not warranted by the words of Timaeus, viz. that this coalescing takes place somewhere *between* the eye and the body looked at. (Timaeus does not say this, and might equally well mean that it happens at the orifice of the pupil or again at the surface of the body looked at.) The words of the passage in the *Placita* are as follows: Πλάτων κατὰ συναύγειαν, τοῦ μὲν ἐκ τῶν ὀφθαλμῶν φωτὸς ἐπὶ ποσὸν ἀπορρέοντος εἰς τὸν ὁμογενῆ ἀέρα, τοῦ δὲ ἀπὸ τῶν σωμάτων ἀντιφερομένου, τοῦ δὲ περὶ τὸν μεταξὺ ἀέρα εὐδιάχυτον ὄντα καὶ εὔτρεπτον συνεκτεινομένου τῷ πυρώδει τῆς ὄψεως. I. e. 'Plato says that (sight is effected) by a fusion of rays, the light of the eye flowing out for a certain distance into the kindred air [this is the clause to which there is nothing in the *Timaeus* to correspond],[1] that from the bodies (seen) moving to meet it, and that in the intervening air, which air is readily diffused and easily wrought upon, being extended along with the fiery (matter) of the eye'. It is the reference to the light 'in the intervening air' which might suggest the 'double coalescence'. But I am not sure that the writer means this; the light of which he speaks may after all be the visual ray itself when it has got ouside the eye into the 'kindred air', so that we merely have a clumsy repetition of what we had already been told in the first clause. Whatever the writer means, he has dragged in the 'kindred air' without any warrant in Plato's text, and this ought to make us very slow to accept his statement as an exegesis of the *Timaeus*. (2) Again, I think it is probably a mistake to suppose that τὸ πρόσωπον in 46 b 2 refers to the special case of a beholder looking at his *own* face in a mirror. The πρόσωπον means *any* face seen in the mirror, just as we speak of the πρόσωπον seen in the moon. The thing to be explained is simply that when I look in the glass I see *a* face (it may be my own or it may be that of some one who is standing by me or behind me). The explanation offered is that the ray of light proceeding from my eye and the light reflected from the *real* face of the person

[1] How has the 'kindred air' got into the account? I think in this way. Timaeus says at 45 d 6 that in the dark the visual fire will not fuse with the neighbouring ἀήρ (συμφυὲς οὐκέτι τῷ πλησίον ἀέρι γιγνόμενον). The author of the notice, whether Aetius or his immediate source, infers from this that in the daytime, when the visual ray ἐκπῖπτον ὅμοιον πρὸς ὅμοιον συμπαγὲς γίγνεται, the ὅμοιον with which it becomes συμπαγές is the 'air'. This is a mere blunder. He also plainly made the blunder of supposing that the ἀήρ of 45 d 6 is 'air'

whom I 'see in the glass' coalesce at the surface of the mirror and the united ray is then thrown back from it.[1] Hence I seem to be seeing the face on or in the mirror, though it is really somewhere else. As for verbal points, the position of *ἐντὸς καὶ ἐκτός*, 46 a 4–5, is due to hyperbation, the phrase really qualifies *τοῦ πυρὸς ἑκατέρου*. In *μεταρρυθμισθέντος* there is no reference to 'deflection' or to angles of incidence and reflection. The word is not uncommon, especially in Aristotle, and means 'having its form changed' (see Bonitz's *Index s. v.*). What is meant is apparently *distortion*, such as would occur in hemi-cylindrical curved mirrors. It is quite in place that in the initial sentence, which is meant to apply to mirrors of all kinds, such distortions should be noticed. Tr. then, 'For owing to the combination of the one fire with the other, of that within with that without, and the production in this case too (*αὖ*) of a single fire at the smooth surface, which is further deformed in various ways, all such reflections inevitably arise, as the fire of the face (seen) coalesces with the fire of the ⟨beholder's⟩ eye (*τῷ περὶ τὴν ὄψιν πυρὶ = τῷ τῆς ὄψεως πυρί*, and the *ὄψις* means, here as elsewhere, the visual ray (which is the true organ of sight according to the theory), at the bright smooth surface.' The reflection is thus accounted for in exactly the same way as ordinary vision, except that the 'coalescing' takes place, in this case, at the surface of the mirror, not—Timaeus probably means to say—at the surface of the actual object seen in this indirect way. The view ascribed by the *Placita* (iv. 14. 3, *Doxogr.* 405) to 'Pythagoras and the mathematicians' (*οἱ ἀπὸ Πυθαγόρου καὶ τῶν μαθηματικῶν*) is just this. 'There is a refraction of the visual current. It proceeds straight to the bronze, and striking on the smooth dense surface is beaten back and turned round on itself. The case is like that of extending our arm and then bending it back towards the shoulder' (*κατ' ἀνάκλασιν τῆς ὄψεως. φέρεσθαι μὲν γὰρ τὴν ὄψιν τεταμένην ὡς ἐπὶ τὸν χαλκόν, ἐντυχοῦσαν δὲ πυκνῷ καὶ λείῳ πληχθεῖσαν ὑποστρέφειν αὐτὴν ἐφ' ἑαυτὴν ὅμοιόν τι πάσχουσαν τῇ ἐκτάσει τῆς χειρὸς καὶ τῇ ἐπὶ τὸν ὦμον ἀντεπιστροφῇ*).

Timaeus is thus giving what seems to be the genuine Pythagorean explanation, and not following Empedocles, who, at least according to the *Placita* (iv. 14. 1), brought in the 'air', as Lucretius does, holding that 'effluences gather at the surface of the mirror, are condensed by the fiery matter excreted from the mirror and carry back with them the air in front of them into which the streams ⟨of effluences⟩ are carried'. But the notice may be due to an Epicurean misunderstanding.

46 b 3–6. δεξιὰ . . . προσβολῆς. We now come to special cases. The first is that of the ordinary plane mirror which seems to interchange right and left. When I see myself in a glass, the right eye of the

[1] Fraccaroli rejects the interpretation of the word *πρόσωπον* given above (which is that of M.) and understands it of the 'face' of the man who is looking into the mirror. He consequently has to regard the whole phrase *τοῦ περὶ . . . γιγνομένου* as a mere repetition of what has already been said. I do not think this likely, and his reasons for the view seem to me unsound, especially the assertion that *πρόσωπον* would be a bad word for the thing seen by the use of the mirror. However, he explains quite correctly that the fire *περὶ τὸ πρόσωπον* means daylight and that *περὶ τὴν ὄψιν* the visual ray, so that his general interpretation agrees with ours on the all-important point that there is not really any image 'in' the mirror.

image is opposite my own right eye, but if a man is actually facing me, his right eye is opposite my left. So Timaeus says that left is seen as right in the plane mirror. The explanation he gives is that 'opposite parts of the visual stream come into contact with opposite parts of the object seen, contrary to the normal rule of the contact'. ὄψις once more means the light issuing from the eye; in the words περὶ τἀναντία μέρη ἐπαφή the περὶ τἀναντία μέρη is the usual periphrasis for a genitive, the meaning being ἐπαφὴ τῶν ἐναντίων μερῶν. So the whole phrase means 'opposite parts of the visual stream have contact with opposite parts ⟨of the object⟩'. By 'opposite' is meant 'opposed to those which come into contact in the normal case of direct vision'. The clause παρὰ τὸ καθεστὸς ἔθος τῆς προσβολῆς is added expressly to define the nature of the opposition intended. The sense, then, is this. In normal vision, if I look at a thing, the left side of the stream of fire issuing from my eyes comes into contact with the right side of the light reflected from the thing, accordingly I see e.g. your left hand facing my right. When I look into a mirror the 'opposite' happens. The light from the right side of the object seen coalesces at the surface of the mirror with the right side of the visual stream from my eyes. Hence a figure seen in the mirror is seen with its right and left sides interchanged. A.-H.'s note explains this correctly, but his rendering 'mutually opposite parts' is misleading. Martin's version is correct, 'the contact takes place between a part of the visual ray and a part of the object seen in a way opposed to that which is usual'.

46 b 6–c 3. δεξιὰ δὲ . . . θάτερον. The second case is that of a hemi-cylindrical mirror held so that the curvature is horizontal. The figure is seen as it would be seen in direct vision, with its left hand opposite the beholder's right. Timaeus says this happens because in this case the φῶς, the ray of light proceeding from the beholder's eye, 'comes over', changes sides (ὅταν μεταπέσῃ), in the act of coalescing 'with that with which it coalesces' (the rays from the object seen). And this 'crossing over' happens because the concave shape of the mirror (this is what is meant by ἔνθεν καὶ ἔνθεν ὕψη λαβοῦσα, the mirror 'has an elevation at either side') makes the right side of the fire from the beholder's eye (the ὄψις), shift to the left and the left side shift to the right.

46 c 3–6. κατὰ δὲ τὸ μῆκος . . . ἀπῶσαν. The third case is that of a hemi-cylindrical mirror with the curvature vertical. From this we get an 'inverted' image, and Timaeus explains the inversion on the same principle which he has just applied to the mirror with horizontal curvature. ταὐτὸν τοῦτο is nominative and subject to ἐποίησεν (so rightly Martin). A.-H. seems to take the words as accusative and in agreement with πᾶν and ὕπτιον, 'it makes this same reflection appear &c.' But so construed the words would really be nonsense. The τοῦτο may be τὸ κάτοπτρον, 'this same *mirror*', as Martin assumes. But I think it more likely that it means 'this same *cause*', viz. the *curvature* (τὸ ἔνθεν καὶ ἔνθεν ὕψη λαβεῖν τὴν τῶν κατόπτρων λειότητα). ἐποίησε is the ordinary 'timeless aorist'. 'But when the curvature is lengthwise to the image, this same cause makes it appear inverted'. The πρόσωπον, as all through the passage, means not the face of the person using the mirror, but the

'face' seen in it. Martin and A.-H. *appear* to adopt the other view, but if they do, they are clearly mistaken. τῆς αὐγῆς in c 5 depends only on the preceding κάτω (not on the ἄνω), and has to be understood again with the following τὸ ἄνω, 'shifting the lower part of the visual ray upwards and its upper part downwards'.

There is a lack of definite information about the theories of other early men of science than the Pythagoreans with which we might compare the explanations just given by Timaeus. We may just refer briefly to the later literature mentioned by Martin in his note. We have to bear in mind that the whole treatment of the topic is beset by a standing confusion between the *reflection* of light from a surface and its *refraction* or bending by the medium through which it travels (air, water, &c.). Both are thrown together under the one name ἀνάκλασις, *refractio*. The fundamental law of reflection was known in later antiquity, but that of refraction was only formulated for the first time in the early seventeenth century A.D. and appears as a novelty in Descartes' *Dioptrique*. Hence the tendency to assume that the facts about mirrors, rainbows, and halos are all of exactly the same kind, all coming under the head of ἀνάκλασις. It is well illustrated by the chapter in Aristotle's *Meteorology* (iii. 4, 373^{a}32–375^{b}15) where he is discussing the rainbow. He begins by saying that of course the bow is an ἀνάκλασις and that *all* smooth surfaces 'refract' or 'bend back' the 'sight' (ἀνακλωμένη μὲν οὖν ἡ ὄψις ἀπὸ πάντων φαίνεται τῶν λείων), a remark which refers to what we call *reflection*. He accounts for this by the 'weakness of vision' and illustrates it by a story of a man with weak sight who was beset in his walks by a phantom of himself, which seemed to be coming to meet him. Ar.'s explanation is that the man's sight being feeble, the air became, as it were, a mirror to him. He then goes on to mention the familiar *mirage* effect, by which, in certain states of the atmosphere, headlands at sea appear with an exaggerated elevation (αἵ τ' ἄκραι ἀνεσπασμέναι φαίνονται ἐν τῇ θαλάττῃ, καὶ μείζω τὰ μεγέθη πάντων, ὅταν εὖροι πνέωσι), and the magnifying effects of a mist on the apparent size of the sun &c. The colours of the rainbow are accounted for by the argument that rain-drops, being mirrors, must reflect something; they are too minute to reproduce the shape of anything, and so there is nothing they can reflect but colour. The cloud in which the bow is seen is thus conceived as a multiple mirror which reflects colour (loc. cit. 373^{b} 24 ἑκάστου δ' ὄντος τῶν ἐνόπτρων μικροῦ καὶ ἀοράτου, τῆς δ' ἐξ ἁπάντων αὐτῶν συνεχείας τοῦ μεγέθους ὁρωμένης, ἀνάγκη συνεχὲς μέγεθος τοῦ αὐτοῦ φαίνεσθαι χρώματος). The theory of mirrors is touched on by Seneca in *Naturales Quaestiones* i. 5 and 7, in connexion with the question whether the rainbow is or is not what Posidonius held it to be, a distorted 'image' of the sun, the rain-cloud being the mirror. There are, we are told, two theories about reflections, one that they are actual bodily offprints ('figuras a nostris corporibus emissas ac separatas'), the other (it is that which we find in the *Timaeus*) that what we see by the aid of the mirror is our own body, beheld by a reflected ray (non imagines in speculo sed ipsa adspici corpora retorta oculorum acie et in se rursus reflexa); Seneca declines to determine the question as it is irrelevant to his immediate purpose. The theory that the 're-

flection' is an actual physical reality, an 'atomic complex' emitted from the body mirrored and then repelled from the surface of the mirror, which it cannot penetrate, towards the observer, seems to have originated with Leucippus and Democritus and was naturally taken over by Epicurus, who is associated with them as holding the view by Aetius at *Placita* iv. 14. 2 (*Doxogr.* p. 408). The Epicurean version is given at some length by Lucretius (iv. 269–323), where we are told that the object seems to be behind the mirror because the 'image of the mirror itself' flung off from the surface reaches our eyes before the 'image of ourself', which has to do the double journey, can reach the mirror and come back again; the right and left sides seem interchanged in the reflection because it is repelled backwards from the mirror, so that it reaches our eye with its 'reverse' foremost! Lucretius wisely says nothing about hemi-cylindrical mirrors.

Since Timaeus makes no attempt to bring his theories about reflections in mirrors into connexion with speculations about the rainbow and the halo, he escapes the confusion of reflection and refraction which is so marked in Aristotle. What makes it impossible to him to give a correct geometrical explanation of the facts about reflections is simply his theory that there is in vision a coalescence of *two* rays, one from the eye and one from the object. Greek geometrical theory of mirrors and their peculiarities is represented for us by the little word called *Catoptrica* attributed to Euclid, but apparently not older than the fourth century of our era, and ascribed by its latest editor Heiberg to Theon of Alexandria (*Euclidis Opera* vii, prolegg. l.). The principle of the equality of the angles of incidence and reflection is the first proposition of this little work, and the interchange of right and left in the plane mirror is explained in Prop. 19. Of course the geometry of these matters is much earlier than the date of the pseudo-Euclidean *Catoptrica*. The foundations of a true theory appear to have been laid by Archimedes. (See the propositions quoted from him in the commentary of Olympiodorus on the *Meteorologica* in Ideler's edition of that work ii. 94 ff. with the editor's notes *in loc.*) It will be noticed that Timaeus says nothing at all about *concave* mirrors.[1]

46 c 7—47 e 2. Timaeus recalls himself from the attempt at a merely mechanical explanation of the process of vision into which he has slipped by reminding his hearers that mechanical causes are subordinate and concomitant to the true primary cause of all these arrangements, the wisdom and goodness of God. We ought to give our first consideration to the purpose with which we have been endowed with sight and hearing. That purpose is to make it possible for us to attain science and virtue. What is really important about sight and hearing is not so much the precise machinery by which they are effected as the kind of life they enable us to lead, the 'world' into which they give us the entrance. What matters to us is what we can do with these senses now we have

[1] There is a passing allusion at *Theaetetus* 193 c 7 where Socrates seems to be adopting the same theory about the 'interchange of sides' in the *plane* mirror as that given here, ἢ καὶ οἷα τὰ ἐν τοῖς κατόπτροις τῆς ὄψεως πάθη (what happens to a visual ray in a mirror), δεξιὰ εἰς ἀριστερὰ μεταρρεούσης.

got them. This is the same principle as that which guides biologists when they say that organs are to be explained by functions.

46 c 7. *τῶν συναιτίων.* The distinction between the cause, in the sense of the 'agent', the *ἀρχὴ κινήσεως* in any process, and the strictly subordinate 'concomitant' or 'assisting' factors, the assemblage of preconditions indispensable to the efficacy of the agent's activity in a given case (the *συναίτια* or *μεταίτια*), is familiar from the passage, so much admired by Leibniz, where it is dwelt on in the *Phaedo* (95 b—99 d). The *συναίτια* are there said to be properly not 'causes' at all but only 'that without which the cause would not be a cause', the *sine qua non* (*ὧν οὐκ ἄνευ*) or indispensable accessory, as distinct from the genuine cause. Socrates' example is that the real cause of his now being seated quietly in prison awaiting execution is not the state of his muscles and bodily machinery in general, but his conviction of duty. He could not sit where he does if he had not bones, muscles, and sinews, but his possession of them is in no sense the *cause* of his behaving as he does. Where we are concerned simply with the formulation of mathematical laws of interconnexion between events, the distinction becomes irrelevant, and this is why so many distinguished men of science wish to expel the very word 'cause' from their vocabulary. They are not concerned with any problem of agency; their question is not what makes an event happen, but simply in accord with what numerical laws can the characters of certain events be calculated, if you know enough about the characters of certain other events. As soon as you begin to deal with the purposive behaviour of agents aiming at a real or supposed 'good', the distinction becomes all-important. In law it is very important to distinguish a 'principal' from the 'accessories' or intermediate agents. The first occurrence of the words *συναίτιος, μεταίτιος* in literature is just in the sense of 'accessory' in an act which has legal or moral consequences, as when in Aeschylus *Agam.* 1116 Casandra calls Clytaemestra *συναιτία φόνου* 'accessory' to the murder of her husband, the 'principal' being Aegisthus, as he himself is made to boast afterwards.[1] The word *αἴτιον* or *αἰτία* itself has a similar juristic origin. The *αἴτιον* is that which is entitled to the legal credit or discredit attaching to an act, that to which the act can be 'blamed'.) Socrates' great point in the *Phaedo* is that just as in his own voluntary acts his choice of what he regards as 'best' is the real cause of his movements, the mechanism of tendons, muscles, and sinews a mere *subordinate* apparatus for giving effect to his choice, so the real cause of the structure of the world is that it is 'best that it should be ordered as it is; the mechanical 'causes' which had engrossed the attention of the physicists are only the *subordinate*

[1] Cf. *Agam.* 810 *πρῶτον μὲν Ἄργος καὶ θεοὺς ἐγχωρίους | δίκη προσειπεῖν, τοὺς ἐμοὶ μεταιτίους | νόστου κτλ.* Agamemnon commits the impiety of calling Heaven a secondary 'helper' or 'ally' in an exploit, the chief credit for which he takes to himself. For the word cf. also *Choeph.* 100 *τήσδ' ἐστὲ βουλῆς, ὦ φίλαι, μεταίτιαι,* i. e. 'take some of the responsibility off my shoulders', ib. 134 *Αἴγισθον, ὅσπερ σοῦ φόνου μεταίτιος.* (Aegisthus is treated in the *Agamemnon* as the real author of the *φόνος*, Clytaemestra as the 'accessory'; *σὺν γυνὴ ἔκτεινε*, l. 1644 should not be 'emended' as the *αὐτός* of that line shows. But it is dramatically right that *Electra* should speak of her mother as the principal, even though this was not the fact.)

machinery by which the realization of the 'best' is brought about. This is also what Timaeus is asserting when he says that the Creator's determination to make the world as good as possible is the true *αἰτία* of all its arrangements, the mechanism, of which frequent mention will be made in what follows, being only a *sine qua non* for carrying out this purpose. The same doctrine is repeated by Plato as his own when he maintains in *Laws* x that *ψυχή* is the *ἀρχή* of all movements whatever and the 'motions of *ψυχή*' are 'older than' all the motions of body. The criticism of the old physicists reappears there too in the form of the complaint that they had treated *φύσις* as an ultimate *ἀρχή*, whereas it is really derivative from *ψυχή* (892 c 2 *φύσιν βούλονται λέγειν γένεσιν τὴν περὶ τὰ πρῶτα· εἰ δὲ φανήσεται ψυχὴ πρῶτον, οὐ πῦρ οὐδὲ ἀήρ, ψυχὴ δ' ἐν πρώτοις γεγενημένη, σχεδὸν ὀρθότατα λέγοιτ' ἂν εἶναι διαφερόντως φύσει*). One may point out that the consideration sets certain limits to the range of physical science itself. When Du Bois-Reymond is illustrating Laplace's fiction of the 'calculating demon' who knows the exact distribution of movement in the universe, he remarks that such a 'demon' would be able to see from his differential equations 'when England will have burned her last ton of coal' (*Über die Grenzen des Naturerkennens* p. 18). But if *ψυχή* is a real cause at all, to predict the date of the exhaustion of the English coal mines, the 'demon' would have to know what the future temper of the miners and the policy of the miners' Trades Union is going to be, and it is a *petitio principii* to suppose that this information is contained in his system of equations. In the present sentence the emphasis falls on *ὑπηρετοῦσι χρῆται*. 'Soul' is not merely one among other 'factors'; it is the controlling factor. An *ὑπηρέτης* is always somebody's 'understrapper', like the plumber's 'boy'.

46 c 8. *τὴν τοῦ ἀρίστου . . . ἰδέαν ἀποτελῶν*. Not 'carrying out the idea of the best' (A.-H.); rather 'achieving the best'. *ἡ τοῦ ἀρίστου ἰδέα* is a mere periphrasis for *τὸ ἄριστον*.

46 d 1–3. *δοξάζεται . . . ἀπεργαζόμενα*. A critical estimate of purely mechanical non-theistic physical science exactly on the lines of the *Phaedo* and *Laws*. The *πλεῖστοι* are not mankind in general, who have no system in their heads and do not ask any questions about the structure of the universe, but 'the majority' of the 'men of science'. This is clear from the words *ψύχοντα . . . διαχέοντα*, which allude to the point that the two principal pairs of 'opposites' in the 'materialistic' systems are the 'hot and cold' (*τὸ θερμόν, τὸ ψυχρόν*) and the 'moist and dry' (*τὸ ὑγρόν, τὸ ξηρόν*). *πηγνύντα τε καὶ διαχέοντα* should not be rendered 'condensing and rarefying' (A.-H.), but 'solidifying and liquefying'. *πήγνυσθαι* is the *vox propria* for the freezing of a liquid or the solidifying of a molten mass as it cools, and the reference is to the opposites *θερμόν* and *ψυχρόν*. Ice is *ὕδωρ πεπηγός*, though it is not 'denser' but 'rarer' than water and therefore forms at the top of a sheet of water.

46 d 5–6. *τῶν γὰρ ὄντων . . . ψυχήν*. This point that *ψυχή*, 'the self-moving', is the *only* thing which exhibits *νοῦς* is repeated because of its philosophical and theological significance. It is meant to exclude what we call 'pantheism', 'de facto teleology', 'unconscious purpose'. Plato, no less than Timaeus, holds it fundamental that where there is regular

orderly motion subserving a 'good' purpose, there is also real and actual mind. The most important proposition about ψυχή in the Platonic philosophy is precisely the 'synthetic *a priori*' proposition that the self-moved'—and that by definition is what the word ψυχή stands for—is the only purposive agent, the only thing which exhibits νοῦς, 'sense', by acting with a purpose. For the meaning of νοῦς cf. its common Attic sense of the 'purport' or 'drift' of a speech or act.

46 d 6. τοῦτο δὲ ἀόρατον. By comparison with 31 b 4 we see that this means that ψυχή is ἀσώματον. It is not meant merely that ψυχή is something too fine for our actual senses to detect; this would be true of the 'corpuscles' into which Timaeus will shortly analyse 'fire, air, water, and earth'; but that it is in its own nature incapable of being 'sensed'. Since we were told at 31 b 4 that τὸ γενόμενον has to be (δεῖ εἶναι) ἁπτόν and ὁρατόν, it follows that ψυχή itself is not a γιγνόμενον *in the same sense* in which bodies are, i. e. that it is not part of the 'passage of nature'.

46 e 1–2. ὅσαι δὲ ὑπ' ἄλλων . . . κινούντων. I. e. ὅσαι (αἰτίαι) γίγνονται κινουμένων μὲν ὑπ' ἄλλων ἕτερα δ' ἐξ ἀνάγκης κινούντων, 'those causes which belong to the class of things which are set in motion by another thing *and of necessity* communicate motion to a third'. The genitives κινουμένων, κινούντων are partitive, like τῆς ἔμφρονος φύσεως above. ἐξ ἀνάγκης = 'without being able to help themselves', i. e. 'mechanically'. If a man strikes me, I can help passing on the blow to a third man, but if I strike the first of a row of billiard-balls which are in contact, it can't help impinging on the next. This is all that ἀνάγκη means here, the point is simply that the ball, unlike a ψυχή, can't 'move' itself or restrain itself. The thought is a combination of the doctrine of the *Phaedo* that the 'good' is the real explanation of everything with the doctrine, first introduced in the *Phaedrus*, of the soul as the one and only 'self-moving' thing. It is only the *self*-moving which can display νοῦς, intelligent purpose. Hence if the structure of the οὐρανός indicates such purpose, it must be due to the action of a ψυχή or ψυχαί.

46 e 5–6. ὅσαι μονωθεῖσαι φρονήσεως . . . ἐξεργάζονται. It is not implied that there is really any such 'random' agent working on its own account in the universe, (as Plutarch's interpretation of the 'psychogony' implied). We have been told already that 'mechanism' plays the part of an 'understrapper' (ὑπηρέτης) to the 'intelligent cause'. All that is meant is that *if* a mere mechanism were left undirected, to work of itself, the results would be 'casual' (τὸ τυχόν). I. e. they would exhibit no tendency to be good rather than bad or the reverse, but would fall out ὡς ἔτυχε, good or bad indifferently. The mechanism, if left undirected, is indifferent to the worth of the result. A mill set working will grind corn or chaff indifferently, or, if you don't 'feed' it at all, it will contentedly damage itself by working with an empty hopper. The great error of the theories which reduce the universe to the status of an unguided machine is that it is forgotten that behind every real machine there is a man somewhere to 'run' it, and the man is not a machine. For τὸ τυχόν in the sense of 'good or bad indifferently' cf. the use of ὁ τυχών for the 'man in the street', e. g. Euripides *Heracles* 1248 εἴρηκας ἐπιτυχόντος ἀνθρώπου λόγους, 'the language of any common fellow', *Rep.* vii. 539 d ὁ τυχὼν καὶ

οὐδὲν προσήκων, 'just anybody without any real aptitude'. Note in e 6 the curious word συμμεταίτια. It looks at first as if the double prefix συμ- μετ- added nothing to the sense which might have been conveyed by συναίτια or μεταίτια. Perhaps, however, the μετ- gives the notion of 'accessory', and the συμ- of an assemblage of such accessories, so that what is meant is 'the *combination* of accessory circumstances'. Timaeus is apologizing for having given an account of the *mechanism* of vision before speaking of the *end* vision serves, what it is good for, the benefit it brings to a species.

47 a 1–c 4. ὄψις δὴ . . . καταστησαίμεθα. The real end served by sight is not merely utilitarian or hedonistic. Sight does help creatures to find their food, avoid their enemies and the like, but these uses are merely ἀναγκαῖα, indispensable if the species is to exist, not ἀγαθά, ends of positive intrinsic value. To use Aristotle's phrase, these results of sight are only contributions to τὸ ζῆν, not to τὸ εὖ ζῆν. The supreme positive and intrinsic value of sight lies in the fact that it is through our eyes that we take in the complicated and yet orderly movements of the heavenly bodies. These provoke our wonder and set us on devising a theory which enables us to recognize the unity of plan under all the apparent irregularity. Sight thus leads to thinking, and thinking to that understanding of the order in things which we call philosophy. The true 'end' of vision is thus philosophy. The steps are these. The sight of sun and moon and the host of heaven leads to the attempt to compare the great and obvious natural periods, to find out how many days there are in a month, or months in a year, or days from one solstice (τροπή) to the next. From such calculations arises the great Pythagorean science, arithmetic. Arithmetic has been held to arise out of commercial transactions, but men were farmers, shepherds, and sailors before they were shopkeepers, and the farmer, shepherd, and sailor need a rough calendar such as that of Hesiod's ἔργα καὶ ἡμέραι. Cf. *Epinomis* 991 b 5–992 a 3.

47 a 4–6. νῦν δ' ἡμέρα . . . ἀριθμόν. Aeschylus also, in the *Prometheus*, a play saturated with the spirit of the early 'sophistic', mentions the determination of the celestial periods (the calendar) as one of the chief boons bestowed on men by Prometheus, and immediately afterwards speaks of arithmetic, probably meaning to indicate a connexion between the two: ἦν δ' οὐδὲν αὐτοῖς οὔτε χείματος τέκμαρ, | οὔτ' ἀνθεμώδους ἦρος, οὔτε καρπίμου | θέρους βέβαιον, . . . ἔστε δή σφιν ἀντολὰς ἐγὼ | ἄστρων ἔδειξα . . . καὶ μὴν ἀριθμόν, ἔξοχον σοφισμάτων | ἐξηῦρον αὐτοῖς. (*P. V.* 454–460).

47 a 7. τῆς τοῦ παντὸς φύσεως. An allusion to the fifth-century name of cosmology περὶ φύσεως ἱστορία (ζήτησις being substituted for the Ionic term ἱστορίη). Cf. *Phaedo* 96 a 7 where Socrates says νέος ὢν θαυμαστῶς ὡς ἐπεθύμησα ταύτης τῆς σοφίας ἣν δὴ καλοῦσι περὶ φύσεως ἱστορίαν, showing that even in 399 an old man could use this rather antiquated name.

47 b 1–2. οὗ μεῖζον ἀγαθὸν . . . ἐκ θεῶν. Cf. *Philebus* 16 c 5 θεῶν μὲν εἰς ἀνθρώπους δόσις, ὡς γε καταφαίνεται ἐμοί, ποθὲν ἐκ θεῶν ἐρρίφη διά τινος Προμηθέως ἅμα φανοτάτῳ τινὶ πυρί. The reference there is more particularly to ἀριθμητική, the science of number. Even here, we must not forget, it is a Pythagorean who is speaking, so that ἀριθμητική will be at least a very important constituent of the φιλοσοφία which he is praising.

47 b 4. ὑμνοῖμεν, not 'hymn', 'celebrate', but 'harp on'; cf. *Protagoras* 317 a 5 οἱ πολλοὶ . . . ἅττ' ἂν οὗτοι διαγγέλλωσι, ταῦτα ὑμνοῦσιν, 're-echo what they hear from' the life of the few prominent men, ib. 343 b 2 γράψαντες ταῦτα ἃ δὴ πάντες ὑμνοῦσιν, *Rep.* viii. 549 e 1 ὅσα καὶ οἷα φιλοῦσιν αἱ γυναῖκες περὶ τῶν τοιούτων ὑμνεῖν. So Ar. *E. N.* ix. 1171ª 15 αἱ ὑμνούμεναι (sc. φιλίαι) ἐν δυσὶ λέγονται. ὀδυρόμενος ἂν θρηνοῖ μάτην. Lindau and St. regarded this as an echo of Eur. *Phoeniss.* 1762 ἀλλὰ γὰρ τί ταῦτα θρηνῶ καὶ μάτην ὀδύρομαι; the *Phoenissae* was produced between 412 and 408, years after any date at which the old Critias, Timaeus, Socrates, and Hermocrates (d. 408/7) could be discussing cosmology. But the trochaic verses at the end of the play, of which this is one, are apparently not the work of Euripides himself. Four of them are borrowed from the *Oedipus Tyrannus* of Sophocles, and it is therefore quite possible that the remaining two may also be reminiscences from some older play, added to the 'acting version' of the *Phoenissae* after the death of the author.

47 b 6–c 4. ἵνα τὰς ἐν οὐρανῷ . . . καταστησαίμεθα. The ultimate aim of φιλοσοφία then is a moral one, the attainment of a certain kind of life. Knowledge of the periods of the circles in the heavens and computation of their ratios to one another (it is to this that the words λογισμῶν κατὰ φύσιν ὀρθότητος μετασχόντες refer) is to lead us to take up the task of bringing the disordered and 'surd' revolutions of the circles in our own souls into a corresponding order. Philosophy is thus the completion of the process which was begun by ὀρθὴ τροφή and παίδευσις, and the end of the whole is, as the *Theaetetus* had said, that we become 'like God'. The particular 'god' Timaeus has in mind is the οὐρανός which is itself an εὐδαίμων θεός. For the Pythagorean source of this conception of the φιλόσοφος as a man who is 'remaking himself' so as to be 'like God', and of science as the great instrument of regeneration see Bt. *Phaedo* xlviii–lv, *Greek Philosophy, Thales to Plato* 41–2, 244–5, *EGPh.*³ 82–4, art. PYTHAGORAS in *ERE.* The present passage should be added to the rest of the evidence that the maxim ἕπου θεῷ comes from the Pythagoreans.

47 c 4–e 2. φωνῆς τε δὴ . . . ἐδόθη. The same thing is true about hearing. Its chief value is that it enables us to apprehend 'discourse' (λόγος) and to perceive musical intervals and scales (ἁρμονίαι), and the great object of busying ourselves with 'consort of sweet sounds' is that we may make our inner life a true melody. Compare the saying quoted at *Phaedo* 60 c 3 that φιλοσοφία is μεγίστη μουσική and Bt.'s note *in loc.*, and remark particularly that the statement that the Pythagoreans 'purged' their souls regularly by music comes from Aristoxenus who had known the last Pythagorean scientific men personally. The famous doctrine of tragedy as a κάθαρσις is pretty clearly connected with this.

47 c 7–d 1. ὅσον τ' αὖ . . . δοθέν. The reference is plainly to song as contrasted with speech (λόγος), but the exact grammatical construction of the clause seems to me uncertain. Chalcidius, Martin, A.-H., Fraccaroli, all take the words as a new principal enunciation parallel to λόγος . . . τέτακται, construing ὅσον μουσικῆς φωνῇ χρησιμὸν πρὸς ἀκοὴν δοθέν ἐστι ἁρμονίας ἕνεκα, 'and all song (all that part of μουσική which is vocal) has been given us likewise for the sake of ἁρμονία,' i. e. to lead us to the study of the

ratios corresponding to the fundamental consonances. This implies that we 'understand' an ἐστί with χρησιμόν. We might, however, take the whole clause from ὅσον to δοθέν as a second subject to τέτακται. 'Speech and all song, which has been given to us for the sake of melody, are both ordained for this very end', viz. the end of leading us to the βίος φιλόσοφος, and I suggest that this is the true construction. As to the words πρὸς ἀκοήν: are they to be taken with χρησιμόν or with the words which follow? Should we render 'all music which is of use to the voice with a view of being listened to', or 'all music which is of use to the voice (has been given) that we may listen to it'. I incline to the second view as giving a better sense, and take T. to mean that the end of vocal music is not to give mere *pleasure* to the singer or the hearer, but to be so listened to that it may awake us to the perception of the melodic intervals. The punctuation of St., M., Hermann in d 4, which puts a comma after νῦν and thus makes δοκεῖ a principal verb, leaving a second δοκεῖ to be understood with καθάπερ νῦν, seems to me intolerable. (Bt.'s punctuation is that adopted also by Jowett and Fraccaroli.) So I would render the whole sentence, 'For speech has been appointed for this very purpose and contributes most of all to it, and again all vocal music, which has been given to us that we may listen to it with a view to the apprehension of melodic form, ⟨serves this end⟩.'

Aristotle reproduces this estimate of the value of hearing, but with a distinction, at *de Sensu* 437ᵃ 11 '*per accidens* hearing contributes more than any other sense to intelligence, for the cause of learning is discourse and discourse is apprehended by hearing, not *per se* but *per accidens*, since it is made up of words each of which is a sign (σύμβολον) of something. Hence, as between those who are congenitally deprived of one of the two senses, the blind are more intelligent than deaf-mutes'. Ar.'s point is that what hearing apprehends is sound or noise, and noise, as such, is not significant. Most noises are 'unmeaning'. This is why he says that it is *per accidens* that hearing is so important for intelligence.

47 d 2–3. συγγενεῖς . . . περιόδοις. For the circles in our souls are constructed on the same plan as those in the ψυχή of the οὐρανός and the ratios corresponding to the melodic intervals were the basis of the whole plan of the cosmic ψυχή. Thus to Timaeus it is no mere fancy that our souls are instruments with the same 'scale' as the οὐρανός. It is precisely because they are made to give that scale that our souls and the 'universe' can 'vibrate sympathetically'. Hence the reason why we can attain by discipline and philosophy to catching the 'music of the heavens' is just that the circles in our souls can execute revolutions answering to those in the heavens. The reason why *only* the φιλόσοφος ever attains to this μεγίστη μουσική is that the revolutions of our circles are thrown out of gear by birth and that it takes ὀρθὴ τροφή + παίδευσις + φιλοσοφία to get them into gear again. The thought here expounded by Timaeus is not only the real meaning of the saying that 'philosophy is the highest music', but is also the very principle assumed by Socrates as the basis of the early education of character through aesthetic taste in *Rep.* iii, so that there again we discover the closeness of the relations between Socrates and Pythagoreanism.

47 d 3–4. οὐκ ἐφ' ἡδονὴν . . . χρήσιμος, the current view being that art, including poetry and music, is a mere 'amusement' intended simply to give pleasure at any cost. Cf. the indignant protest of *Laws* ii. 656 c 1 *ὅπου δὴ νόμοι καλῶς εἰσι κείμενοι ἢ καὶ εἰς τὸν ἔπειτα χρόνον ἔσονται τὴν περὶ τὰς Μούσας παιδείαν τε καὶ παιδιάν, οἰόμεθα ἐξέσεσθαι τοῖς ποιητικοῖς, ὅτι περ ἂν αὐτὸν τὸν ποιητὴν ἐν τῇ ποιήσει τέρπῃ ῥυθμοῦ ἢ μέλους ἢ ῥήματος ἐχόμενον, τοῦτο διδάσκοντα καὶ τοὺς τῶν εὐνόμων παῖδας καὶ νέους ἐν τοῖς χοροῖς, ὅτι ἂν τύχῃ ἀπεργάζεσθαι πρὸς ἀρετὴν ἢ μοχθηρίαν;*[1] So Aristotle holds that it is merely an *accidens* of good music to be *ἡδύ*, *Pol.* Θ. 1339^{b} 31 *συμβέβηκε δὲ τοῖς ἀνθρώποις ποιεῖσθαι τὰς παιδιὰς τέλος· ἔχει γὰρ ἴσως ἡδονήν τινα καὶ τὸ τέλος, ἀλλ' οὐ τὴν τυχοῦσαν, ζητοῦντες δὲ ταύτην, λαμβάνουσιν ὡς ταύτην ἐκείνην . . .* (ib. ^{b} 42) *οὐ μὴν ἀλλὰ ζητητέον μήποτε τοῦτο μὲν συμβέβηκε, ταμιωτέρα δ' αὐτῆς ἡ φύσις ἐστὶν ἢ κατὰ τὴν εἰρημένην χρείαν.* For the common-place view cf. e.g. *δισσοὶ λόγοι* 2, 28 (Diels *Fr. d. Vors.*[3] ii. 339) *ποιητὰς δὲ μαρτύρας ἐπάγονται, ⟨οἳ⟩ ποτὶ ἀδονάν, οὐ ποτ' ἀλάθειαν ποιεῦνται* ('whose aim is the entertaining, not the real'.) And compare Milton's saying that the poet should make his life a poem.

47 d 7–e 2. καὶ ῥυθμὸς . . . ἐδόθη. The best comment on this is furnished by the account given in the *Laws* of the way in which the first random kicks and sprawlings of children may be transformed into rhythmic dancing and the value of this discipline for the early training of character. Cf. *Laws* ii. 653 d 7 *φησὶν δὲ τὸ νέον ἅπαν ὡς ἔπος εἰπεῖν τοῖς τε σώμασι καὶ ταῖς φωναῖς ἡσυχίαν ἄγειν οὐ δύνασθαι, κινεῖσθαι δὲ ἀεὶ ζητεῖν καὶ φθέγγεσθαι . . . τὰ μὲν οὖν ἄλλα ζῷα οὐκ ἔχειν αἴσθησιν τῶν ἐν ταῖς κινήσεσιν τάξεων οὐδὲ ἀταξιῶν, οἷς δὴ ῥυθμὸς ὄνομα καὶ ἁρμονία· ἡμῖν δὲ οὓς εἴπομεν τοὺς θεοὺς συγχορευτὰς δεδόσθαι, τούτους εἶναι καὶ τοὺς δεδωκότας τὴν ἔνρυθμόν τε καὶ ἐναρμόνιον αἴσθησιν μεθ' ἡδονῆς.*

47 e 3—48 e 1. Τὰ μὲν οὖν παρελήλυθότα . . . λέγειν. Timaeus now proposes to begin a great part of the story of creation over again and to tell it with more exactness and detail. So far we have *in the main* (*πλὴν βραχέων*) been dealing with the rational or final cause of the *οὐρανός*, showing how its general plan answers to the Creator's purpose to make it the '*best* of all possible worlds'. (The reservation *πλὴν βραχέων* refers to the account of the mechanism of vision with its appendix on reflections in mirrors.) In the rest of the dialogue we shall mostly be concerned with the subordinate machinery by which the result is attained, theories about the molecular structure of the 'four roots', the chemical composition of bodies, the tissues of living organisms, and the like. In fact, we are at last entering on 'positive' science. For our former purpose it was enough to say roughly that the body of the *οὐρανός* is made of the four Empedoclean 'roots', and that the bodies of the lesser organisms it contains are in their turn compounds of them. But now we have first to see whether we cannot analyse the 'roots' themselves, and then to try, if we can, to specify the formulae of combination characteristic of the various compounds of them. We have been talking all along as if we knew

[1] Cf. also *Laws* ii. 658 e 6 *συγχωρῶ δὴ τό γε τοσοῦτον καὶ ἐγώ τοῖς πολλοῖς, δεῖν τὴν μουσικὴν ἡδονῇ κρίνεσθαι, μὴ μέντοι τῶν γε ἐπιτυχόντων, ἀλλὰ σχεδὸν ἐκείνην εἶναι Μοῦσαν καλλίστην ἥτις τοὺς βελτίστους καὶ ἱκανῶς πεπαιδευμένους τέρπει, μάλιστα δὲ ἥτις ἕνα τὸν ἀρετῇ τε καὶ παιδείᾳ διαφέροντα.*

exactly what earth, water, air, fire are, though we have never defined any of them. This is quite proper according to the theory of scientific method explained in the *Phaedo*. We have 'assumed' (ὑπεθέμεθα) that there are these 'roots' and deduced the 'consequences' (τὰ συμβαίνοντα) of the 'assumption' (ὑπόθεσις), that a divine intelligence makes a world by combining them in the best way. Now we proceed to examine our ὑπόθεσις itself and to ask whether these 'roots' are not themselves of a complex character, so complex that not only may we not call them the στοιχεῖα, *elementa*, *ABC* of nature, but must not even call them 'syllables' of her language. The point then is that T. is now leaving 'divinity' and about to propound a scheme of mathematical physics. The assumptions which had been sufficient so long as we were mainly concerned with natural theology are much too crude for this new purpose. We must therefore seek much more ultimate ἀρχαί of body. In doing so, T. is turning from the 'true αἰτία' to study the subordinate συναίτια on their own account, and it is therefore quite in place that he should call attention to the change in standpoint.

If we bear in mind the teaching of the *Phaedo* (101 d), that one should first examine the consequences of one's initial assumptions before one goes on to 'give an account' of the assumptions themselves, there is no reason why we should doubt that from the first Plato meant to make Timaeus work with the Empedoclean roots so long as he found them adequate for his purpose and then attempt an analysis of them, just as he is getting to the point where he will find it necessary to admit the possibility of their transformations into one another. So long as he does not need to recognize that a volume of one of these 'roots' may be transformed into a volume of another, there is no need to attempt to get behind them. But the whole scheme of physics which he is now about to expound depends on the interchangeability of three of the 'roots' with one another. The analysis by which it is explained why these three are interchangeable is absolutely necessary at the stage where it is brought in and would have been superfluous at any earlier stage. Again the analysis itself is just the sort of thing we should expect if Timaeus was at once a Pythagorean mathematician and, like Philolaus, an adherent of the Sicilian medical school, and, as we shall see in the sequel, this is what he is depicted as being. He would have to face the very question he is just about to raise, how to bring the biology and sense-physiology of Empedocles, which was founded on the acceptance of the four 'roots', into one coherent scheme with the Pythagorean mathematician. Hence theories like that propounded by Wilamowitz, who fancies that Plato had written the *Timaeus* down to 47 c before he fell in with the works of Democritus, from which he discovered that he must begin his account of nature all over again, are really simply superfluous. There is no need to bring in Democritus, and it is perhaps most likely that Plato had never read his works. We cannot prove such a proposition, but we shall at least see that there is not a single sentence in the *Timaeus* which shows any knowledge of Democritus. Moreover, it is very doubtful whether Plato would have learned anything from Democritus if he had read him. With all his eminence as a stylist and man of letters, Democritus belonged

to the most reactionary of all schools in cosmology. If Plato, whose main connexions were with Italian Pythagoreans and Eleatics, had ever heard of him, it was probably as one of the antiquated persons who still continued to believe in a 'flat earth'. And I do not believe that if Plato had wished to criticize Democritus he would have put his criticisms into the mouth of an elderly fifth-century Pythagorean.[1]

47 e 4–5. διὰ νοῦ δεδιημιουργημένα . . . δι' ἀνάγκης γιγνόμενα. Note the significance of the change of verb. The effects of νοῦς are 'the works of its hands', those of ἀνάγκη merely 'occur from ἀνάγκη'. The distinction is intended to make it quite clear that the purposiveness ascribed to God is *genuine* purpose, not that substitute for it which some modern philosophers call '*de facto* teleology' or *quasi*-teleology'. There is no *quasi* about the Theism of either Timaeus or Plato.

Henceforth νοῦς and ἀνάγκη are the regular names used for what have hitherto been distinguished as the true αἰτία or the αἰτία which is an ἔμφρων φύσις and its 'accessory' or 'accomplice'. The name seems to carry Pythagorean and Orphic suggestions. This is shown by the fact that it is given to the goddess who constructs everything and 'holds lots' (κλῆροι) in the second part of the poem of Parmenides, and also explains why Ἀνάγκη is the central figure in the myth of Er in the *Republic*. But, as Proclus rightly insisted in commenting on that myth, the ἀνάγκη of the *Timaeus* is not this great Orphic-Pythagorean figure. The goddess of the *Republic* 'presides' over the destinies of all things and is an unmistakable symbol of intelligent divine purpose and providence. In the *Timaeus* ἀνάγκη has definitely the part of 'understrapper' and is contrasted as unintelligent and purposeless with the ἔμφρων φύσις, or, as Proclus puts it, the Ἀνάγκη of the *Republic* ἄρχει θεῶν, the ἀνάγκη of the *Timaeus* is only κινητικὴ σωμάτων.[2] Clearly then the ἀνάγκη of our dialogue is not the great Orphic-Pythagorean figure which became the Fatum or εἱμαρμένη of Stoicism and has inspired Horace's ode to the *diva gratum quae regis Antium* (C. i. 35). I can only account for the common ἐπωνυμία by supposing that Timaeus is deliberately *deposing* the Orphic Ἀνάγκη to a subordinate place in the scheme of things. This must be done with a specifically theistic purpose, to exclude all danger of making the supreme goodness and wisdom what the Stoics in fact made it, an impersonal 'immanent' world-force. Proclus is also clearly right in distinguishing the ἀνάγκη of which Timaeus speaks from the εἱμαρμένη of the *Politicus* myth. That is a force which is supposed to act only in that half of a complete 'cycle' when God has retired from the helm (*Politicus* 272 e 6), whereas ἀνάγκη here is the permanent 'accessory'

[1] The 'fresh start' is thus exactly like that made in the closing pages of *Republic* E, where we discover that our φύλακες have to be men of science and dialecticians. In both cases, the alleged 'fresh start' arises naturally in the development of the argument, and in both it has been made, equally unwarrantably, the basis for idle speculations about Plato's methods of composition.

[2] Proclus in *Remp.* (Kroll) ii. 206 *εἰ οὖν αὕτη μὲν ἡ Ἀνάγκη θεῶν ἄρχει, ψυχῶν νοερῶν ἐπιβέβηκεν, ποδηγεῖ τῇ βουλήσει μόνῃ τὸν κόσμον ἐξηρημένας, ἐπιτροπεύει τοὺς βιοὺς τῶν μερικῶν ψυχῶν, . . . ἐκείνη δὲ τῶν σωμάτων ἐστὶν κινητικὴ καὶ οὐ τῶν αὐτοκινήτων ὑποστάσεων, καὶ τούτων προεστῶσα μόνων ἐφεστῶτος δεῖται τοῦ νοῦ, . . . πῶς ἂν προσήκοι τοσούτοις αὐτὰς διεστῶσας ἀπ' ἀλλήλων οἴεσθαι τὰς αὐτὰς εἶναι διὰ τὴν ἐπωνυμίαν κοινὴν οὖσαν;*

of Providence in the management of things. Of course, we must not, like Plutarch, identify ἀνάγκη with a wholly irrational 'bad' world-soul, a sort of 'metaphysical evil' in things. Ἀνάγκη is not supposed to be inherently bad; her function is to be the indispensable 'underworkman' of νοῦς in the production of a 'good' world, and though not herself purposive she is responsive to intelligent purpose, since we hear repeatedly of νοῦς 'persuading' ἀνάγκη. Again we must not confuse ἀνάγκη with 'scientific necessity' or 'the reign of law', for she is expressly called (48 a 7) the πλανωμένη αἰτία, the 'rambling' or 'aimless' or 'irresponsible' cause, probably, as Bt. has said, with an allusion to the name πλανητά for the apparently 'irregular' members of the starry host. Thus it is not the 'necessary' but the 'contingent', the things for which we do not see any sufficient reason, the *apparently* arbitrary 'collocations' in nature which are the contribution of that which Plato calls here ἀνάγκη. Recognizable law is credited by Timaeus to νοῦς, and is just what satisfies Plato himself in the *Laws* that the world is ordered by the Providence of God. Thus, if we want to grasp the meaning of Timaeus, we must not take ἀνάγκη to represent anything inherently lawless and irrational, and yet we must not take the word to mean necessity in the sense of conformity to law. We must bear in mind that ἀνάγκη is a personification of that which has already been described as 'subserving' Mind and being Mind's subordinate agent—something which, if left to itself, *as it never is*, would be, not indeed 'bad', but indifferent to the worth of the results it produces. We might identify this something with what Kant and others have called 'mechanical' causality, but only if we make several important *distinctiones*. (1) Plato emphatically does not mean that some things are due to intelligence and others to mere mechanism. 'Mechanism' comes in only as the 'subordinate' of intelligent purpose, which is the 'principal' in all undertakings. Apparently ψυχαί are altogether the products of intelligence, but nothing is the unaided product of ἀνάγκη. (2) Also, as the name πλανωμένη αἰτία shows, this 'mechanism', if we are to call it so, is supposed to be most prominent in the apparently anomalous, exceptional, and singular. I take it this means that where we can see a rational connexion in nature we are dealing with what Timaeus calls a creation of νοῦς. Especially all arrangements which we can see to contribute to an end of intrinsic worth and so to help to make the world 'good' must be ascribed to νοῦς. Hence the circular revolutions in the heavens are said to be due to νοῦς and even the structure of the eye is described before we come to the discussion of the 'subordinate cause'. But there is in the world a good deal of what we may call 'brute' fact. We know it is there but we do not see 'what the good of it' is, though, if we think with Timaeus and Plato, we feel satisfied that it subserves *some* good end. Take for instance the apparent anomalies of the planets. It was clearly Plato's own view, and it is hinted by Timaeus, as Bt. says, that the explanation of some of them is that the movements look lawless to us because we are viewing them from a moving earth. Now if the earth moves, we may be sure 'it is best' for it to move and to have the motions it in fact has and not others; some intrinsically good end is subserved which would not be

subserved by an earth 'at rest at the centre', or moving in some way other than that in which the earth actually moves. But *we* do not know what this end is and consequently do not see *why* it is best that the earth should have just the motion it actually has. That it 'goes up and down on the axis of the all' or 'revolves round the central fire' at such and such a distance and with such and such a period are to us mere 'brute' facts or 'ultimate collocations'. I think then that what Timaeus means to put down to the score of ἀνάγκη is not quite what Kant calls 'mechanism'. It is specifically those 'conjunctions' for which we can see no justification in the form of a valuable result, and have to accept simply as 'given fact'. Thus *we* should say that what Newton worked out was a '*mechanics* of the solar system', but Timaeus regards the execution of a regular orbit in a definite period as due not to ἀνάγκη but to νοῦς 'persuading' or 'overruling' ἀνάγκη. This is because we *can* see why it is valuable that a planet should move in a closed curve and have a regular 'period'. If our earth did not move in a closed orbit, it could never have been the permanent abode of living beings, and if its period were less regular, not only would science never have arisen, but in all probability we should never have learned the virtues of foresight, patience, and industry which, in fact, the agriculturist learns from having to count on, be ready for, and wait for the regular returns of sun and rain in their 'due season'. And it is *good* that the earth should be the home of beings who follow *virtute e canoscenza*. But why should the earth further e.g. have the precise dimensions it has? Why should it not be larger or smaller? Timaeus would probably say that in some way the universe would be the poorer, but that we do not know precisely in what way. We therefore put the fact e. g. that the earth's diameter is 8,000 miles, not 5,000 nor 10,000, down to ἀνάγκη. If this is what is meant, it follows that the more insight we get into the structure of things, the more we understand how one modification, by entailing others, would lead to the destruction of results which have intrinsic value, the smaller will be the part in the actual arrangement of the οὐρανός that our philosophers will have to accept as bare unexplained fact. If we could ever have complete knowledge, we should find that ἀνάγκη had vanished from our account of the world. But since the sensible world itself is an ἀεὶ γιγνόμενον and never complete, there can be no complete knowledge of it. So that this last consideration should create no difficulty except for persons who are dull enough to take the personification of ἀνάγκη literally. When we bear in mind that ἀνάγκη is by definition a system of conjunctions which subserves the purpose of νοῦς to make the world 'as perfect as a γιγνόμενον can be', we shall see, I think, that what has been said is a legitimate expansion of the actual words of Timaeus. Note that the contrast of νοῦς and ἀνάγκη is worked out on definitely Pythagorean lines; the 'random' or 'arbitrary' motions set down to ἀνάγκη stand to the definite motions referred to νοῦς as their ἀρχή exactly as ἄπειρον to πέρας.[1] An interesting illustration of the distinc-

[1] A good example of the πλανωμένη αἰτία is afforded by Newton's gravitational astronomy. The 'rational postulates' of the system are the three Newtonian 'laws of motion', but the 'appearances' are not deducible from these alone, but from the laws of motion *plus* the further assumption that between any two material particles

tion which Timaeus calls that of νοῦς and ἀνάγκη from the biological point of view is afforded by the opening chapter of Aristotle *de Partibus Animalium* A. 639ª ff., where there seems to be conscious reproduction of the Platonic phraseology. Aristotle is arguing that the old φυσικοί left the *main* problem of anatomy and physiology untouched. They thought they had accounted for the structure of our organs when they had said what they are made of, (the *material* cause). But an even more important question is that of the *final* cause of these organs, (what they are meant to do); this you can only learn by studying their functions, seeing what advantage they confer on their possessor. That there is something analogous to *purpose* in nature, i. e. that all organs and tissues contribute to some end which is of value to their possessor, is clear. 'We say *this is for the sake of that* in all cases where a process is found to culminate in a certain result if it be not artificially hindered' (ὅπου ἂν φαίνηται τέλος τι πρὸς ὃ ἡ κίνησις περαίνει μηδενὸς ἐμποδίζοντος, 641ᵇ 24). In fact the reason why we can devise arts and crafts which aim with conscious foresight at achieving a result, such as building a house or curing a patient, is that we have in us a spark of intelligence which we have derived from the corresponding principle in nature. The real answer to the question *why* a creature has e. g. lungs, or even to the question what a lung is, is given by explaining what it does in the working of the living body. Aristotle explains, therefore, that in anatomy and physiology we have *first of all* to discover the οὗ ἕνεκα or τέλος, the 'what for' or final cause, of each structure. The question what the structure is made of, what is its 'matter', though important, is subsidiary. This 'material cause' he calls τὸ ἐξ ἀνάγκης, the *sine qua non* (642ª 1–10), giving as an example the iron or other hard metal of which an axe-blade is made. If you want to cut wood, you must have iron or the like to make your implement of. But in explaining what an axe is, the first thing is to explain what it is intended to do. It is a better definition of an axe to say that it is 'an instrument for cleaving' than to say that it is an iron thing, though a complete account of the axe would go on to point out that hard workable material like iron is a *sine qua non* of our having serviceable axes. (So all through the *de Partibus* Aristotle opposes the consideration of τὸ βέλτιον, the function subserved by an organ, to that of τὸ ἀναγκαῖον, the mere explanation of the way in which the general mechanism of the body makes certain arrangements of the organs inevitable.) If we remember that we have to be content to accept the presence of iron in the solar system as 'brute fact', we shall see that Aristotle's distinction between the οὗ ἕνεκα or final cause and the *sine qua non*, or, as he calls it, the ἐξ

there is a gravitational attraction 'directly proportional to their joint mass and inversely proportional to the "square" of the distance between them'. There is nothing in the three 'laws of motion' themselves to show why 'material particles' should behave according to this particular formula. It is a case of 'bare conjunction' or 'brute fact'. This is the reason why Newton himself felt that there is a *causa* gravitatis, i. e. an explanation of the fact that the gravitation-formula holds, though he was unable to say what that explanation is. 'Hactenus Phaenomena coelorum et maris nostri per Vim gravitatis exposui, sed causam Gravitatis nondum assignavi. . . . Rationem vero harum Gravitatis proprietatum ex Phaenomenis nondum potui deducere, et Hypotheses non fingo' (*Principia*, bk. iii, *Scholium Generale*).

ὑποθέσεως ἀναγκαῖον (what must be there *if* a certain result is to be achieved), corresponds exactly to that of Timaeus between the 'best' and the 'necessary', as that distinction, in turn, coincides with the distinction of the *Phaedo* between the 'real cause' and 'that without which the cause could not be a cause'. That Aristotle is actually taking the distinction from these sources is indicated by the remark made in the *de Partibus*, that the defectiveness of the earlier treatment of the subject was due to the neglect of systematic definition. 'Progress was, indeed, made in this respect in the age of Socrates, but the prosecution of natural science flagged (ἔληξεν), as those who were philosophizing turned away to the study of useful virtue and the art of government' (πρὸς τὴν χρησιμὴν ἀρετὴν καὶ τὴν πολιτικήν, 642ª 29–30). For a good brief discussion of the ἀνάγκη of the *Timaeus* see further C. Baeumker *Das Problem der Materie in der griechischen Philosophie* (Münster, 1890) 115–26. And cf. the words of E. Meyerson *L'explication dans les Sciences* i. 109, 'nous ne pouvons plus, à l'heure actuelle, nourrir l'espoir de voir la science résoudre la réalité sensible en un mécanisme, ni, en géneral, en aucun système rationnel'.

48 a 1–2. ἐξ ἀνάγκης καὶ νοῦ συστάσεως, i. e. ἐκ συστάσεως ἀνάγκης καὶ νοῦ 'from a combination of ἀνάγκη and νοῦς'.

48 a 3. τὰ πλεῖστα. How do we know that νοῦς is successful in 'persuading' ἀνάγκη 'in the majority of cases'? Obviously this is inferred from the growing discovery of rational connexion, as science advances, where at first we began by seeing only 'conjunction', to use Hume's famous antithesis, and from nothing else.

48 a 5–7. εἴ τις . . . πέφυκεν. 'If we are to give a faithful account of γένεσις, we must bring in the πλανωμένη αἰτία—as it is implied we have not done in what we have said up till now. What omission is intended to be signalized? We see from 48 b below that the defect in the former narrative is meant to be that it merely *assumed* the four 'roots' as something ultimate. This is now to be corrected by an account of their γένεσις which turns out to be an analysis of their respective molecules into their simple geometrical constituents. How can the performance of this analysis be spoken of as the introduction of the πλανωμένη αἰτία into our theory? In this way. We took it before as something calling for no explanation to speak of that there are just these four 'roots'. On consideration we see that what is distinctive of the 'roots' is their geometrical structure. On more serious reflection it occurs to us that the four geometrical forms characteristic of their respective molecules are only a selection out of the infinitely numerous possible configurations in space. This selection is presumably the work of purposive intelligence aiming at a 'good'. In a more complete theory, therefore, we must start further back. We must start with the infinity of possible configurations and explain the principle on which just these four have been selected for the corpuscles of the 'roots'. Put into the form of a 'story' of creation, this will mean beginning with a state of things in which the corpuscles have not yet received these precise and definite configurations, in fact an ἄπειρον of geometrical configurations in three dimensions. This consideration of a state of things in which definite molecular structure does not yet exist is what is meant by bringing in the πλανωμένη.

αἰτία. The selection of the four definite forms which correspond to the four 'roots', on the ground of a property peculiar to them which will be pointed out, is a case of '*νοῦς* persuading *ἀνάγκη*'.

ᾗ φέρειν πέφυκεν. The phrase is correctly rendered, so far as the words go, by St.'s *ratione qua ipsius natura fert*, 'so far as its nature permits'. But it is not quite clear whether the literal meaning of the *φέρει* is (*a*) 'endures', 'puts up with', hence 'admits of', or (*b*) 'tends'. To me it seems that *φέρει* means 'endures'; we must take *ἀνάγκη* into account 'as far as its own nature admits'. The qualification is necessary because you cannot give a *complete* explanation of the *πλανωμένη αἰτία*, since its very nature is such that it always leaves you with a residue of unexplained 'conjunction' on your hands. If you ever succeeded in complete 'explanation', you would have seen exactly *what* every arrangement in nature is 'good for', and then there would be no *πλανωμένη αἰτία* left in your theory. Cf. Whitehead (*Concept of Nature* 141–2), 'Nothing in nature could be what it is except as an ingredient to nature as it is. . . . The isolation of an entity in thought, when we think of it as a bare 'it', has no counterpart in any corresponding isolation in nature. . . . The laws of nature are the outcome of the characters of the entities which we find in nature. The entities being what they are, the laws must be what they are; and conversely the entities follow from the laws. We are a long way from the attainment of such an ideal, but it remains as the abiding goal of theoretical science.' The recognition of the *πλανωμένη αἰτία* means just that this ideal is and will always remain 'a long way off'.

48 b 2–3. περὶ τῶν τότε . . . τούτων. *τὰ τότε*, 'the former inquiry', refers, as A.-H. says, to the account of *τὰ διὰ νοῦ δεδημιουργημένα*. More precisely the reference is to 27 e ff., where the 'appropriate' *ἀρχή* for our whole discussion was the distinction between *ὄν* and *γιγνόμενον*. *ἀρχή* here means simply 'starting-point' for a discussion. We have now to ask ourselves in the same way whether it is a sufficient starting-point for mechanics and chemistry to assume that there are four primary bodies and that we know just what their properties are, or whether we must start this kind of discourse further back by analysing the 'roots' into still simpler constituents. The real reason why we have to take this second course is that Timaeus holds that in what we should now call chemistry we meet appearances which require us to admit the transmutability of three of the four 'roots'. Therefore we cannot treat the 'roots' as ultimate. We have to explain the transmutability of three of them and also the intransmutability of the fourth. That Timaeus is specifically referring back to the passage indicated is shown by the correspondence of the prayer at 48 d 4–e 1 with the similar prayer of 27 d. Unless our whole method of interpretation has been mistaken, Timaeus does not mean to say that the 'roots' once existed before the function of any world, and that a formless chaos before them. He means that so far we have talked of these 'roots' exactly as if every one understood without explanation just what each of them is, and as if further account of them were as unnecessary as impossible. Now we have to ask whether it is not both possible and necessary to make a scientific study of this *γένεσις*, this con-

struction or structure. This is done, in fact, by a 'corpuscular' theory, the differences between the 'roots' being held to depend in the end on geometrical differences between their corpuscles. Pythagorean mathematics are going to take us behind the postulates with which the biologist Empedocles was content to start.

The general idea expressed in the formula that *ἀνάγκη* is the 'accessory' or 'accomplice' of *νοῦς* in the scheme of things reappears in Aristotle as the repeated assertion that 'God and nature' do nothing 'in vain' (*μάτην*), i. e. without an end of value which is subserved. This does not mean that nature is like a workman deliberately aiming at a foreseen result, but simply that all natural arrangements subserve a function, have a use, and that to understand any structure we need to know its function, the benefit it confers on its owner. Nature 'does nothing in vain', or, as Ar. also says, 'acts for the best' in the sense that its machinery is just that which is adapted to the production of intelligent and moral beings. How completely Ar. agrees with Plato about this comes out most clearly in a passage (*de Partibus Animal.* Δ. 687ª 8) where he criticizes the old physicists exactly in the tone of Plato's *Laws*. 'Anaxagoras says that man is the most intelligent of animals because he has hands. The rational view is that he has hands because he is intelligent. For the hand is an implement, and nature, like a sensible man, regularly distributes her implements to those who can use them. For it is more in place to give flutes to a flute-player than to assign flute-playing to him who possesses a flute, as this is making the minor an adjunct to the major and more important, and not the worthier and major an adjunct to the minor.' [Ar. means that it would be silly to distribute the instruments to the members of the band at random and then expect the man who happened to get a flute to play 'first flute'. The sensible thing is to see that each instrument is given to the man who knows how to play it.] 'If this then is the better way, and if nature produces the best the conditions allow of' (*ἐκ τῶν ἐνδεχομένων ποιεῖ τὸ βέλτιστον*, where the *ἐνδεχόμενα*, the initial restrictions, answer to T.'s *ἀνάγκη*), 'it follows that man is not the most intelligent animal because he has hands, but has hands because he is the most intelligent. For the most intelligent being can make a good use of more implements than other creatures, and the hand is not one implement but many. . . . So nature has assigned the hand, the most useful of implements, to the creature who is capable of attaining the widest range of accomplishments (*τῷ πλείστας δυναμένῳ δέξασθαι τέχνας*).'

48 b 3–5. *τὴν δὴ πρὸ τῆς οὐρανοῦ . . . πάθη.* The two problems meant are (*a*) the specification of the characteristic corpuscle of each 'root' (*πυρὸς . . . φύσιν*), (*b*) the resolution of the corpuscles themselves into their ultimate geometrical elements as specific determinations of the spatial continuum, the 'construction' of the corpuscles out of 'triangles' (*τὰ πρὸ τούτων πάθη*).

48 b 5–6. *νῦν γὰρ οὐδεὶς . . . μεμήνυκεν.* The influences drawn from these words at *EGPh.*³ 293 n. 3 are hardly warranted. There is no special allusion to the 'regular solids'. *αὐτῶν* refers to the Empedoclean roots, which have just been enumerated. All that is meant is that no physicist has investigated the structure of earth, water, &c. duly. The

names have been used as though they had a definite signification, too familiar to require any explanation. But Timaeus holds, as is explained later on, that each of the four names is currently given loosely to a great range of bodies of mixed structure.

48 b 7. ἀρχάς. In the simplest sense, 'beginnings', 'starting-points' (of a λόγος περὶ φύσεως). Empedocles begins his λόγος about φύσις by saying 'there are four bodies of which everything is made, earth, water, &c.', just as if his hearers knew beforehand exactly what earth is or what water is, and needed no enlightenment on that point. It might be worth considering whether the use of ἀρχή in the philosophical sense of 'first principle', 'ultimate', 'source', and so forth is not historically derived from this sense of 'starting-point of a *discourse*'. The ἀρχαί of the φυσικός are just the things with which he 'begins his story' of the κόσμος.

48 b 8. στοιχεῖα τοῦ παντός. Literally 'the *ABC* of everything'. On the whole history of the word and the varied meanings it acquired, one should study Diels's essay *Elementum*, Leipzig, 1899. The word first occurs in extant philosophical literature at *Theaetetus* 201 e 1, where Socrates says that he seems to remember having heard 'in a dream' a view of 'some persons' that the *ABC* of things, the *elementa* of which they are built up, as syllables and words are of letters, λόγον οὐκ ἔχει. This is explained to mean that you can 'give account of' a 'syllable' by spelling it, as when you say that the first syllable of Socrates' name is S-O. But you can't spell out the letter S or the letter O. If a man is not *directly* acquainted with the sound of S, you can't reveal it to him by analysing it into any combination of simpler sounds. So, according to the 'persons' in question, scientific knowledge (ἐπιστήμη) consists in knowing what simple constituents make up a complex. But you cannot have 'knowledge' of the simple constituents themselves, you are 'acquainted' with them but do not 'know' about them (*loc. cit.* 202 a 8 *νῦν δὲ ἀδύνατον εἶναι ὁτιοῦν τῶν πρώτων ῥηθῆναι λόγῳ . . . τὰ δὲ ἐκ τούτων ἤδη συγκείμενα, ὥσπερ αὐτὰ πέπλεκται, οὕτω καὶ τὰ ὀνόματα αὐτῶν συμπλακέντα λόγον γεγονέναι· . . . οὕτω δὴ τὰ μὲν στοιχεῖα ἄλογα καὶ ἄγνωστα εἶναι, αἰσθητὰ δέ· τὰς δὲ συλλαβὰς γνωστάς τε καὶ ῥητὰς καὶ ἀληθεῖ δόξῃ δοξαστάς*. (Bt., who otherwise gives an excellent account of this passage in *Greek Philosophy, Thales to Plato* 250–2, should not have used the misleading expression that it is a theory of 'unknowable simple reals'. That suggests doctrines of the type of Herbart's, in which we are supposed to have no cognition at all of the 'reals'. According to the persons to whom Socrates is alluding we are supposed to be directly acquainted with them; all that is denied is that we can 'know about' them. The distinction is exactly that which has reappeared in recent philosophy as the distinction between 'knowledge of acquaintance' and 'knowledge *about*'.) There has been much discussion about the source of this theory. There is pretty obviously a reference to some actual persons who had held that we can apprehend the *ABC* of nature directly, but cannot 'give account' of the letters. Some have brought in Antisthenes (commonly but wrongly[1] called the founder of the 'Cynic

[1] As Wilamowitz has said in his vigorous protest against 'Antisthenes-Legende' in his recent *Platon* ii. 163–4, it ought to be obvious (1) that there were no 'Cynics' before

school'), here as in many other places where there are obscure personal allusions in Plato. The only excuse for this is that Aristotle, discussing this very theory (*Met.* H. 1043^b 23 = R.P. 286), incidentally remarks that it gives some colour to a difficulty raised by 'the Antistheneans and such uncultivated persons' (ὥστε ἡ ἀπορία ἦν οἱ Ἀντισθένειοι καὶ οἱ οὕτως ἀπαίδευτοι ἤπορουν, ἔχει τινὰ καιρόν). The ἀπορία was that you cannot explain what a thing *is* (its οὐσία) by a definition, you can only explain what it is *like*, as e. g.—(I take the illustration to be Aristotle's own)—you cannot make a man understand by language what silver *is*, though you can explain that it is like tin. The difficulty was thus that a definition only gives you *predicates* or *qualities* of a thing, never the thing itself (which is tacitly assumed to be the 'owner' of the qualities), since a definition is a predication (τὸν γὰρ ὅρον λόγον εἶναι μακρόν, ib. 1043^b 26). There is really no very special connexion between this imaginary objection to definitions (which Aristotle treats contemptuously as due to ἀπαιδευσία, ignorance of logic), and the view mentioned by Socrates in the *Theaetetus*, which is the real topic Aristotle is considering. According to that view you can define and ought to define everything except the *ABC* itself by analysing the complex 'words' of nature back into their syllables and letters; science consists in performing this analysis. According to the view ascribed by Aristotle to the Ἀντισθένειοι, *no* definition is of any value at all. The ἀπορία, which Aristotle treats merely *en passant* as an ignorant blunder, belongs to general logical theory; the doctrine of which Socrates is speaking in the *Theaetetus* is manifestly a physicist's theory of the structure of nature. Now Antisthenes was notoriously not a physicist at all, but an obstinate disputant, a rhetorician and a moralist. Also, as we see from the *Phaedo*, Antisthenes was a close associate of Socrates down to the time of the latter's death. So that it seems absurd to represent Socrates as 'dreaming' that he had heard the theories of Antisthenes.[1] Cf. C. Ritter, *Platon* i. 209 ff.

Diels, rightly seeing that the theory must be that of a physicist, suggested in his *Elementum* (pp. 13 ff.) that it comes from Democritus, on the ground that Democritus notoriously compared the atoms of his theory with letters of the alphabet and the complexes they form with syllables (Aristot. *Met.* A. 985^b 4 ff. = R.P. 192). If Plato himself knew nothing of Democritus, this cannot be the true explanation. In any case it would not be safe to infer that Democritus was the originator of the comparison he used. Indeed there is an obvious reason why no atomist is likely to have invented it. The *ABC* of a language, of course,

Diogenes, the ἀπλοκύων, and (2) that there never was a Cynic 'school' at all, there was only a coterie of 'originals' like Diogenes and Crates. A school means organization, regular teaching and a common theory, and it is ridiculous to talk of these in connexion with men whose whole notoriety was due to their offensive personal eccentricities.

[1] See in the same sense Burnet *Greek Philosophy, Thales to Plato* 251-2. It has been suggested that Antisthenes only put forward the theory after the death of Socrates, who therefore has to become acquainted with it in a prophetic 'dream'. There is no evidence whatever for this suggestion. If other considerations pointed to Antisthenes, we might be allowed to venture on it. But they all point to a physicist or physicists as the real authors of the doctrine.

must contain only a finite, and not very numerous, set of simple signs. The atomists held that the variations in size and shape among their simple bodies are infinite, and it is not very natural to compare an infinite aggregate of different 'figures' with an *ABC*. Presumably Democritus borrowed his illustration from some one else whose theories it fitted better. Now we know that the Pythagoreans held that bodies are made of regular geometrical figures. This is the standing presupposition of Aristotle's arguments against the Pythagorean doctrine that things are 'numbers'. We get it in our own dialogue, when Timaeus proceeds to build up all bodies out of the 'regular solids' and these figures themselves out of two different kinds of primary triangle. He, so to say, constructs the words of the language of nature out of an alphabet of two letters which can be combined so as to produce four syllables. It is exactly the type of theory which would most readily suggest the idea of an *ABC* of a few 'letters' with which the whole book of nature can be written. Hence, with Bt., I think Professor Lewis Campbell was on the right track when he suggested in his edition of the *Theaetetus* that the persons of whom Socrates had 'dreamed' were Pythagoreans. Perhaps the *Timaeus* helps us to explain the reference to the 'dream'. The conversation of Socrates with Theaetetus is supposed to take place in the very last weeks of Socrates' life, just before his trial. If the Pythagoreans of the fifth century used the comparison, and if Socrates had met some of their leading men and conversed with them about cosmology more than twenty years before, we can quite understand why he speaks in his old age of a 'dream-like' recollection of something he had heard so long ago from men still older than himself. I do not think it necessary to suppose that the allusion is to theories which had sprung up after his death. (The idea of the *ABC* recurs in Bacon's well-known conception of the 'true forms' which it is the business of science to discover as not more numerous than the letters of the alphabet, and in our common metaphor of 'reading in the book of nature'.[1]

48 b 8. οὐδ' . . . ἐν συλλαβῆς εἴδεσιν. Fire, air, &c. are not even 'syllables', because syllables are formed directly out of the *ABC*. But in the theory of Timaeus most of what passes for 'fire', 'air', &c. is not pure but compound, and even the corpuscles of 'pure' fire, &c. are not formed directly from his 'letters', the two primary triangles, but only indirectly, by first forming their 'faces' out of combinations of the two primary triangles. Thus it is the 'faces' of the solid corpuscles which, on Timaeus' theory, are the 'syllables'; the corpuscles themselves would be words, and the bodies formed of a number of corpuscles the sentences, paragraphs, &c. of nature's book. If it sounds odd to speak of nature as a work written in an alphabet of only two letters, it may be

[1] *Of the Advancement of Learning*, bk. ii: 'For as to the forms of substances... the forms of substances, I say (as they are now by compounding and transplanting multiplied) are now so perplexed, as they are not to be inquired; no more than it were possible or to purpose to seek in gross the forms of those sounds which make words, which by composition and transposition of letters are infinite. But on the other side to inquire the form of those sounds or voices which make single letters is easily comprehensible; and being known induceth and manifesteth the forms of all words, which consist and are compounded of them.'

worth while to indicate a very simple way of constructing the book with such an alphabet. Suppose we take an ordinary co-ordinate system of three planes at right angles to one another. Any point in space will then be completely determined by assigning three numbers, the three co-ordinates of the point. We may then e. g. determine any 'corpuscle' unambiguously by giving the three co-ordinates of each of its angular points, since any two which have the same angular points will be identical. We can thus map out the whole distribution of the corpuscles at a given moment by giving the numbers which are the co-ordinates of their angular points relatively to our chosen axes. Now let us write these numbers not in the ordinary 'denary' scale of notation, but in a 'binary scale'. Then we shall require only two numerical signs 0 and 1, and shall write the series of integers 'from 0 to ten', for example, as follows, 0, 1, 10, 11, 100, 101, 110, 111, 1,000, 1,001, 1,010. In this way we could contrive to give a very Pythagorean formula for the 'distribution of matter at the instant *t*' without using any symbols but 0 and 1. We should have reduced our physical 'alphabet' to two letters.

48 c 2–4. **τὴν μὲν περὶ ἁπάντων . . . οὐ ῥητέον.** Note that Timaeus is careful to say that the analysis he is about to give is not ultimate. The *ἀρχή* or *ἀρχαί*, or whatever you like to call them, which he is going to take as his starting-points may not be the furthest back which cosmology can reach. What he is going to take as the *ABC* of things may be capable of further analysis, only 'for our present purposes' we shall not try to analyse any further. This is the proper attitude for a scientific man. All analysis of nature leaves us with constituents which are relatively simple but may quite well prove on minute scrutiny to be only relatively so. This is all that is meant, and it is obviously true. So in our own lifetime the 'atom' has given place to the 'electron' as the physicist's simple 'real', and no one, I suppose, doubts that attempts may yet be made to find something still simpler than the 'electron'. Timaeus is explaining that since one must make a 'start' somewhere, he is content to start with the triangles which will presently be introduced, but that he does not mean to say that science must for ever regard these triangles as defying all further analysis. Possibly we might see in the words one of the rare occasions on which Plato allows himself to be detected behind his characters. We might fancy that a hint is intended that what was ultimate for a fifth-century Pythagorean is no longer so for the Academy. But we are not forced to adopt this interpretation. It was part of the dialectic method as described in the *Phaedo* to start by making a 'postulate' (*ὑπόθεσις*) and examining its consequences, always bearing in mind that the postulate itself may be called in question and will then have to be itself examined. In the *Parmenides* Socrates is represented as actually learning this method from Parmenides and Zeno. So that it is chronologically perfectly possible that Timaeus, a contemporary of Zeno and like him an Italian, should know all about the necessity of holding a postulate with the reservation that it may hereafter be necessary to get behind it. We must bear in mind that our whole cosmological doctrine is 'provisional' (an example of *εἰκότες λόγοι*), and that it would be false in principle to ascribe finality to any part of it. The hint that even in

cosmology it might be possible to get further back than the starting-point we are adopting is carefully repeated, when we come to the description of the primary triangles themselves, at 53 d 6–7.

48 c 4–d 1. δι' ἄλλο μὲν οὐδέν . . . ἐπιβαλλόμενος ἔργον. Thus the reason for not attempting to start with something still more primitive than the *ἀρχαί* which Timaeus means actually to adopt is merely the difficulty of doing so 'in a discourse like the present', i. e. the intolerable prolixity to which the speaker would be condemned if he had to begin his story at a still earlier point and to justify his selection of it. If you are to give a general sketch of 'natural science' as a whole in a single discourse of moderate compass, you must not start *too* far back from the 'appearances'. It seems to be distinctly implied that but for his undertaking to compress his account of *γένεσις*, up to and including the emergence of man, into a single 'lecture', Timaeus himself is quite capable of starting with more remote *ἀρχαί*.

48 d 2–4. πειράσομαι . . . λέγειν. There is no variant of any importance in the text of these words in MSS. or in the ancient testimonia. But the traditional text seems quite incapable of translation. (Chalcidius apparently found it so, as he omits the words which create the trouble.) The difficulty is to make sense of the *ἔμπροσθεν*. The editors before Bt. print the words *μᾶλλον δὲ καὶ ἔμπροσθεν* without any comma at *δέ* and take them all together. This increases the difficulty of construing and is, I venture to think, obviously wrong. The *μᾶλλον δέ* plainly answers to the preceding *ἧττον*. C. W. rightly points out that A.-H. gives one explanation in his note and adopts another in his version, and that neither can be got out of the Greek. In the note he tries to make *ἔμπροσθεν*, 'before', mean 'where we were before'. This seems impossible enough, but in the translation he renders *ἔμπροσθεν λέγειν*, 'to describe, *beginning from where* we were before', and this seems still more impossible. St. proposes to read *μᾶλλον δὲ κατὰ τὰ ἔμπροσθεν* ('I shall try to give a description not less probable than another's,) but more in accord with our former procedure'. This would be grammar and Greek, but there seems to me two fatal objections to it: (1) that it gives a very false antithesis, 'a description not less probable *than another man's*, but even more in accord with what *I* have already said'; (2) and it neglects the patent fact that *μηδενὸς ἧττον μᾶλλον δέ* go together and are an example of the Greek fondness for fullness of expression. Another suggestion is to read *μᾶλλον δὲ ἢ κατέμπροσθεν*, 'but even more probable than before'. It has been objected to this that there seems to be no other example of a word *κατέμπροσθεν*, but I think C. W.'s rejoinder that the analogy of *κατόπισθεν* and *καθύπερθεν* is sufficient defence of the form a reasonable one. The real objection to such a change is simply the severance of the *μᾶλλον δέ* from the *ἧττον*, but that objection seems insuperable. Apelt suggests 'emending' *ἔμπροσθεν* to *ἓν πρὸς ἕν*, which he supposes to mean *bei genauer Betrachtung alles Einzelnen*, 'when all points of detail are taken into account'. For the phrase *ἓν πρὸς ἕν* he compares *Laws* i. 647 b 4 *καὶ τὴν ἐν τῷ πολέμῳ νίκην καὶ σωτηρίαν ἓν πρὸς ἓν οὐδὲν οὕτως σφόδρα ἡμῖν ἀπεργάζεται*, v. 738 e 5 *δεῖ δὴ πάντα ἄνδρα ἓν πρὸς ἓν τοῦτο σπεύδειν*, and also the use of the same phrase at Herodot. iv. 50 *ὕδωρ γε ἓν πρὸς ἓν*

συμβάλλειν ὁ Νεῖλος πλήθεϊ ἀποκρατέει, Thuc. ii. 97 *οὐδ' ἐν τῇ Ἀσίᾳ ἔθνος ἓν πρὸς ἓν οὐκ ἔστιν ὅτι δυνατὸν Σκύθαις ὁμογνωμονοῦσι πᾶσιν ἀντιστῆναι*. None of these passages, however, really affords a parallel for the sense Apelt proposes to put on *ἓν πρὸς ἓν*. In every case the phrase means 'comparing one thing with another', and so 'taking one thing with another', 'on the whole account'. I think then that none of the proposed translations or corrections which I have seen really remove the difficulty of the passage, and I may be excused if I offer a suggested remedy of my own for what it may be worth. I suggest that there has been a loss of three letters before *καί* and that we should read *μηδενὸς ἧττον εἰκότα, μᾶλλον δέ, ⟨τῶν⟩ καὶ ἔμπροσθεν*, where *μηδενός* is to be taken as *neuter* and *τῶν* as partitive genitive depending on it, 'I shall try to make a statement which is not less but more probable than anything which has been said before since we began'.[1] In support of this I would compare *τοῖς ἔμπροσθεν λεχθεῖσιν* in e 5 just below. The insertion of the *τῶν* would give exactly the sense required by the context. By making a more careful distinction of three factors, where only two had been distinguished before, Timaeus hopes to give a more accurate provisional sketch of cosmology than he has hitherto offered us. The 'things said before' are shown by the context to mean only what he has said about *αἰσθητά*, where *ἀνάγκη* is a factor; he does not mean that the coming 'likely story' is nearer the truth than what he has said about the 'eternal'.

48 d 4–7. *θεὸν δὴ . . . λέγειν*. Cf. the prayer with which the whole discourse opened at 27 c–d, to which the *καὶ νῦν* expressly refers us back. The phrase *ἐξ ἀτόπου καὶ ἀήθους διηγήσεως* has been taken to imply that *Plato* is conscious of the difficulty and novelty of the theories he is going to propound. But it may mean no more than that Timaeus expects them to be strange to *his* audience in the fifth century. Hence we cannot build any confident conclusions on it. The metaphor in *διασῴζειν* is that of asking a god to grant you safe passage to port—a familiar port, as it seems to be suggested—across a difficult water. (Did the words suggest Wordsworth's famous lines about Newton's statue with their image of 'a mind for ever | Voyaging through strange seas of thought?') The port to which a safe passage is entreated is *τὸ τῶν εἰκότων δόγμα*. His hearers will feel themselves safe in 'home waters' when the theory has got so far as to bring in the 'four roots', (this is plainly the particular *δόγμα* he has in mind), and to explain other things as compounds of them. The stormy sea which the vessel must cross before it makes these 'home waters' is the geometrical construction of the 'roots', or rather the account of space which is preliminary to that construction. It is this which Timaeus foresees the others will find it hard to follow.

48 e 2—49 a 6. *Ἡ δ' οὖν . . . τιθήνην*. The main refinement made in our restatement of our doctrine of body is that at first, when our immediate purpose was simply to distinguish the eternal from the 'passing', we could work with a mere pair of antithetical terms, the

[1] I find from n. 136 in Apelt's translation that this insertion of *τῶν* had already been proposed by Mrs. Hammer-Jensen ('Plato und Demokrit' in *Archiv für Geschichte der Philosophie*, vol. 23, p. 98), a fact of which I was unaware when I wrote the words in the text. M. Rivaud has neglected to record the conjecture in his *Apparatus* (1925).

opposition between the *νοητόν* which is 'model' or 'pattern' and the *αἰσθητόν* which is *μίμημα*, 'copy'. So long as we were content to assume as a sufficient analysis of bodies that they consist of four 'roots' which are themselves sensible bodies, combined in various ways, this distinction of the eternal 'intelligible' from the 'passing' sensible was enough for our needs. But now that T. is about to make the distinctive qualities of the 'roots' themselves (the hardness of earth, the fluidity of water and so forth) depend on the geometrical structure of their particles, this analysis is no longer sufficient. We have to get back to the notions of shape and voluminousness as something common to all the 'roots', which only differ because the shapes and sizes of their corpuscles differ. We have to regard the 'filling of a volume with a definite contour' as just as much a fundamental and universal character of nature as the filling of a duration about which we have already heard so much. Timaeus intends to identify corporeality, with the filling of a contour, exactly as Descartes did. The statement that 'a body with such and such qualities is now here' is going to be explained to mean 'such and such sensible events are now going on in such and such a volume'. This involves forming a notion of volume in general, and the conception of the whole volume filled by all of 'that which goes on'. Consequently, we shall need henceforth to distinguish not merely two things but three, (*a*) the *παράδειγμα*, 'pattern' or 'model', (*b*) its passing 'copy' (*μίμημα*), a qualified event or complex of events perceptible through our senses, (*c*) what Timaeus calls the 'receptacle' (*ὑποδοχή*) or 'matrix' (*ἐκμαγεῖον*), or yet again the 'mother' (*μήτηρ*) or 'nurse' (*τιθήνη*) of all 'becoming', that 'in which' passage occurs. This is space conceived *more geometrico*.[1] The life of nature is thought of as made of sensible events of specific types or patterns taking place in or over volumes. (It is understood, though not expressed, that these volumes 'overlap', so that they yield a whole volume-continuum which is filled by the whole 'passage of nature'.) The types of the events are the *παραδείγματα*; they do not 'occur', it is 'instances' of the types which occur; these instances, the actual events, are the *μιμήματα* of the different types; the extension which as a whole is filled by the whole 'passage of nature', while its 'regions' are filled by the partial events we can distinguish within each pulse of this whole passage, is the *ὑποδοχή* or *ἐκμαγεῖον* or *τιθήνη γενέσεως*. T. finds it necessary to be verbose and to employ a variety of images to convey this notion of the 'volume' filled by the passage of nature because of the

[1] T.'s account of *χώρα* has given rise to much discussion in both ancient and modern times, and numerous attempts have been made to show that by *χώρα* T. really means something like the Peripatetic *πρώτη ὕλη*, the mere 'potentiality' of the existence of the various actual bodies apprehended by sense, or like the Stoic *ἄποιος ὕλη*, body without qualities. I do not set myself to refute these interpretations, since I hold that the work has been done once for all in an admirable fashion by Bäumker (*Problem der Materie* 126–88). There are subordinate points of detail in which I should find it hard to agree with him, and I should regard what he calls Plato's 'confusion' of physical and geometrical bodies as no confusion at all. But on the main issue that Plato means to identify body with *res extensa* he seems to me to have said the last word. If any one needs to be further fortified by 'authorities', it is sufficient to name Boeckh and Zeller.

difficulty of putting the idea of 'timeless space'—that is what he is talking about—clearly before the mind of any one but a trained mathematician. We may remember that according to Aristotle the Pythagoreans themselves did not clearly distinguish the volumes in which events occur from the events themselves, or, as he puts it, they regarded their numbers as identical with 'sensible things' (ὁ μὲν—Plato—τοὺς ἀριθμοὺς παρὰ τὰ αἰσθητά, οἱ δ' ἀριθμοὺς εἶναί φασιν αὐτὰ τὰ πράγματα, *Met.* A. 987b 27). If that is true Timaeus would be in advance of many of his own order in his clear conception of a thing so abstract as 'timeless space'. It is not likely that there is anything in his exposition which would be novel or difficult to the eminent mathematicians of the Academy. Theaetetus, the true founder of solid geometry, and Eudoxus, the real first inventor of the Integral Calculus, could have found nothing to perplex them, and both were pretty certainly dead before the *Timaeus* was written. But, in the light of what Aristotle says about the Pythagoreans, it is credible that in the fifth century even Socrates might be expected to find the exposition a little hard to follow. It seems to me a sheer mistake to discover in the imagery by which Timaeus tries to lead up to the concept of 'timeless space' any novel 'later theory of (Platonic) Ideas'. We shall see on 51 b ff. that when the Forms are expressly spoken of, it is precisely in the spirit of the *Phaedo*. Besides, if it is ever legitimate to make a distinction between metaphysics and mathematics at all, we must make it here and say that what Timaeus is expounding in 49–50 is not metaphysics but the *principia mathematica philosophiae naturalis*. He begins, then, by saying that the entity he now wishes to introduce as a third term into his analysis of 'passage' is 'a receptacle (ὑποδοχή) and a nurse (τιθήνη) of all becoming'. This is, so far, merely preliminary; he does not yet explain that what he is thinking of is χώρα, 'room'. He means to prepare the way for that explanation by a series of illustrations. So, of course, the word ὑποδοχή is a mere metaphor which has still to be justified, not a definition.

To appreciate the illustration which follows, we must begin by forgetting all about the artificial 'materialistic' interpretations of nature which assume solid bits of 'matter' as permanent things in which or between which, so to say, perceptible events go on. This interpretation of nature has, as it happens, coloured our language so deeply that it is hard for us at first to realize how very artificial an interpretation it is. But we must make the attempt to get back to a condition in which we can look at the 'appearances' as they present themselves to an observer not yet biased unconsciously in favour of a 'materialistic' theory. Then we shall see nature simply as a great complex of overlapping events of various kinds each with its duration and volume. (For the point of view compare Whitehead *Concept of Nature* i–ii.) Now, looking at the appearances, Timaeus says, it seems we must hesitate to call anything water rather than fire or one of the other 'roots' with any assured confidence. For we say, for example, 'there is water here now', but (after a frosty night) what we 'find here' is solid ice, and that seems more like earth or stone than like water. But again heat will evaporate this solid lump (when the sun gets up), so that what, from the standpoint of the believer in the

'roots' began by being water and then seemed to turn into stone, now seems to have become wind and therefore 'air', and 'air set on fire (*ἀὴρ συγκαυθείς*, i. e. heated gas) seems to be more properly reckoned as 'fire'. And the process may be reversed. Fire seems to pass into 'air', 'air' by condensation into 'cloud' and 'mist' and by still closer packing into 'water' (as the cloud comes down in rain), and water seems to become 'stones' and 'earth'. (This may refer either to the formation of ice, as the reference to *λίθοι* suggests, or to the solidification of streams, e. g. of lava by cooling, or to the deposits of earth brought down by rivers and deposited in their 'deltas' or to all three.) So that we get the *appearance* of a regular 'cyclical' permutation of the 'roots', and this suggests that they are not the genuine 'roots' of reality at all. Of course Timaeus is not here referring to the permutations which he is going shortly to adopt in his own account; as yet he is merely saying that the interchangeability of all the 'roots' *seems*, on the face of it, to be a fact (*ὡς δοκοῦμεν*, 49 b 8, *ὡς φαίνεται*, c 7, *φανταζομένων*, d 1). As yet we are not in a position to say whether these transformations really take place or only 'seem'; they are mentioned only to make it clear that the distinctive *qualities* of the Empedoclean 'roots' (*θερμὸν–ψυχρόν*, *ὑγρὸν–ξηρόν*) are not the permanent or invariant *in* the appearances.

The whole passage is full of echoes of early Ionian cosmology. The 'cyclical' transition of the 'four' familiar bodies into one another was the standing doctrine of the earlier science, before the criticism of Parmenides had driven home the conviction that what really is cannot merely 'arise from' and 'vanish into' something permanent, but must have something invariant *in* it and persisting through it. Parmenides was possessed by the thought that change, if it is real at all, is 'change in the permanent'. As this conception appeared paradoxical, he drew the conclusion that change is only an illusion. His pluralistic successors have the task laid on them of saying what the 'permanent' which persists through change is. Empedocles had found it in the 'roots' as opposed to their perishable compounds. His thought, if he had only possessed language in which to express it, was that the distinctive qualities of each of these 'roots' (hot, cold, moist, dry) remain permanent throughout all their combinations. Timaeus also is concerned to find a solution of the problem, but his solution goes deeper than that of Empedocles. He begins by a sketch of the 'appearances' as they would present themselves to minds which had not yet grappled with Parmenides' statement of the critical problem, minds of the 'pre-Parmenidean period'.

The general idea of the 'cyclical' transformations of bodies is common to all the pre-Parmenideans. It is expressed by Anaximander in what is the only or almost the only actual quotation from him that has come down to us. 'Into that out of which things arise, they also vanish at the due season; for they make reparation and atonement to each other for their aggression at the appointed time' (Theophrast. *Phys. opin.* Fr. 2, *Doxogr.* 476 = R. P. 16 *ἐξ ὧν δὲ ἡ γένεσίς ἐστι τοῖς οὖσι, καὶ τὴν φθορὰν εἰς ταῦτα γίνεσθαι κατὰ τὸ χρεών· διδόναι γὰρ αὐτὰ δίκην καὶ τίσιν ἀλλήλοις τῆς ἀδικίας κατὰ τὴν τοῦ χρόνου τάξιν.* Cf. *EGPh.*[1] 52–5). Anaximenes first presents us with a theory of the process by which the transmutations

are effected; it is πίλησις, 'packing', 'felting', by which ἀήρ becomes water and water earth; the opposite process is 'rarefaction'. The language of Timaeus is intended to be reminiscent of this version of the theory. It is what he is alluding to in the reiterated mention of 'condensation' and 'rarefaction' (πυκνούμενον c 4, συμπιλουμένων, an echo of the actual vocabulary of Anaximenes, c 5). And the selection of ἀήρ as the illustration of a so-called 'substance' which *becomes* everything else is due to the fact that it was ἀήρ which was the 'primary body' in the system of Anaximenes. It is from him, too, that the suggestion that νέφος and ὁμίχλη are 'air' in the first stage of 'felting', c 4–5, is taken. Cf. the summary given by Simplicius *in Physica* 24 of Theophrastus' account of Anaximenes (*Fr. d. Vors.*[3] i. 22, *Doxogr.* 476 = R. P. 26) μίαν μὲν καὶ αὐτὸς τὴν ὑποκειμένην φύσιν καὶ ἄπειρόν φησιν . . . οὐκ ἀόριστον δὲ . . . ἀλλὰ ὡρισμένην, ἀέρα λέγων αὐτήν· διαφέρειν δὲ μανότητι καὶ πυκνότητι κατὰ τὰς οὐσίας. καὶ ἀραιούμενον μὲν πῦρ γίνεσθαι (cf. *Tim.* 49 c 1–2) πυκνούμενον δὲ ἄνεμον (*Tim.* 49 c 2 πνεῦμα), εἶτα νέφος, ἔτι δὲ μᾶλλον ὕδωρ, εἶτα γῆν, εἶτα λίθους. Even more verbally in accord with the expressions of Timaeus is the version of the same passage from Theophrastus in Hippolyt. *Refut. Haer.* i. 7 (*Fr. d. Vors.*[3] i. 23, *Doxogr.* 560 = R. P. 28) πυκνούμενον γὰρ καὶ ἀραιούμενον διάφορον φαίνεσθαι· ὅταν γὰρ εἰς τὸ ἀραιότερον διαχυθῇ, πῦρ γίνεσθαι, ἀνέμους δὲ πάλιν εἶναι ἀέρα πυκνούμενον, ἐξ ἀέρος ⟨δὲ⟩ νέφος ἀποτελεῖσθαι κατὰ τὴν πίλησιν, ἔτι δὲ μᾶλλον ὕδωρ, ἐπὶ πλεῖον πυκνωθέντα γῆν καὶ εἰς τὸ μάλιστα πυκνότατον λίθους. Though the allusions to πίλησις show that it is primarily the 'philosophy of Anaximenes' which Timaeus is thinking of, the remark about the 'cycle' (48 c 6) is meant also to remind us of Heraclitus and the ὁδὸς ἄνω καὶ κάτω. Timaeus says, in effect, that by his theory that the life of the world is kept up by a constant 'exchange' of 'fire' for other things and other things for 'fire', Heraclitus had found the 'general formula' for the early Ionian cosmological systems. The very semblance of permanence in things is only due to the 'stability of the exchanges'; there appear to be permanent things only because there is about as much of the 'primary' stuff taking the 'upward' path at any given moment as there is taking the 'downward'.

At 49 b 4 note that καθ' ἕκαστον in the phrase ἅπαντα καθ' ἕκαστόν τε is virtually an indeclinable noun, 'all and each'; it is hard to find good grounds for calling any of the 'roots' water or anything else in particular rather than for calling it all and each. This is a step in the direction of Aristotle's technical vocabulary, largely, no doubt, created in the Academy.

49 d 3–e 7. οὐκ ἔστιν . . . ἔχῃ γένεσιν. Timaeus agrees with Heraclitus about the cyclical transformation of bodies, though with a reservation. There is one of the four, 'earth', which, for good reasons, is excluded from the cycle. Otherwise—and in this he shows loyalty to the historical connexion of Pythagoreanism with early Milesian cosmologies—he pronounces against Empedocles' way of facing the problem by simply asserting that the four 'roots' are nature's invariants. A man ought to be ashamed to call any of them an invariant; they are only passing phases in the life of nature (49 d 1–3). His way of expressing this is

to say that nothing which we see changing its character (*ἄλλοτε ἄλλῃ γιγνόμενον*, d 5) ought to be called 'this' (*τοῦτο*); it should only be called *τοιοῦτον*, 'this-like'. We must never use words about 'fire' and the like which would suggest that they are permanent 'things', i. e. we ought not to use substantives, or pronouns which are equivalent to them, in speaking of *γιγνόμενα*. We should use only adjectives and adjectival pronouns, as that suggests rightly that what the words stand for is only a 'phase' of something, a mere adjectival qualification of the really permanent.

49 d 5. ὡς πῦρ. He selects 'fire' as his first example because it is the 'primary body' of Heraclitus. Just because he agrees so closely with Heraclitus about the cyclical transformations, he wishes to lay emphasis on his disagreement with him about 'fire'. H. after all held that 'fire' is a permanent substantival reality in a way in which other things are not. It is 'exchanged' for water or earth and they for it, and yet in some way H. holds that water and earth are 'phases' of fire, while fire is not a 'phase' of them but 'the real thing'. There is, of course, an inconsistency here. If you are really in earnest with the doctrine of cyclical transformations, you must hold that whatever it is that is invariant throughout change, it cannot be a sensible body. *All* sensible bodies must be on the same level; if one of them is a 'phase', all must be 'phases'.

49 d 5–e 2. μὴ τοῦτο . . . ἡγούμεθά τι. Throughout this sentence *τοῦτο* and *τὸ τοιοῦτον* are predicative. 'Whenever we see anything becoming different, fire for instance, we must in every case call fire not "this" but "this-like", and again must not call water "this" but "this-like".' (Martin goes wrong here, regarding *πῦρ* and *ὕδωρ* as predicative, *τοῦτο* and *τὸ τοιοῦτον* as the direct objects of *προσαγορεύειν*, and so making the text really untranslatable.) In the next clause the construction appears to be *μηδὲ ⟨προσαγορεύειν τοῦτο⟩ ἄλλο μηδὲν . . . ⟨τούτων⟩ ὅσα* κτλ., 'nor yet must we use the expression "this" of any of the supposed *things* we fancy we are indicating when we point them out by the use of the words *τάδε* and *τοῦτο*, as though any of them had any permanent being'. The meaning is that, in ordinary life, we speak of what common language calls 'things', e. g. stones and the like, as 'this' and 'that', words which can only be properly used of a *τι* or 'somewhat', a something substantial and permanent. But this is an abuse of language. Stones and the like have no *βεβαιότης*, 'permanence', since they are *γιγνόμενα* and no *γιγνόμενον* is *βέβαιον*. The antecedent to *ὅσα* must be the 'things which we mistakenly suppose to be permanent'. For the subject of the following *φεύγει* cannot well be anything but the *ὅσα*, and it is the things falsely supposed to be permanent which *φεύγει*. Chalcidius translates differently, and, as it seems to me, wrongly. He writes: Hoc quod saepe alias aliter formatum nobis uidetur et plerumque iuxta ignis effigiem, non est, ut opinor, ignis sed igneum quiddam, nec aer sed aerium, nec omnino quicquam habens ullam stabilitatem. Denique ne pronominibus quidem ullis signanda sunt quibus in demonstratione uti solemus cum dicimus *hoc* vel *illud*. fugiunt enim &c. That is, he stops heavily after *βεβαιότητα*, so as to connect the words *μηδὲ ἄλλο . . . βεβαιότητα* with what goes before; we are not to call any 'appearance' fire or water or anything else permanent. This leaves *ὅσα* without any

antecedent, and Ch. has to interpolate a clause *denique ... signanda sunt* to which there is nothing in the Greek to correspond. A.-H. avoids the mistake of separating the μηδὲ ἄλλο ... βεβαιότητα from the following words, but evidently supposes the construction to be μηδὲ ⟨προσαγορεύειν⟩ ἄλλο μηδὲν ὅσα ... 'nor to call anything else by *any of the predicates* which we express by the use of the words *this* and *that*, supposing that we are signifying something by doing this'. This seems to me wrong for the following reasons: (1) δεικνύντες means not 'signifying' but 'pointing to', 'denoting'; hence the ὅσα which it governs must be the *things we point out* when we speak of 'this' or 'that', not 'predicates which we express.' In fact, when I call a thing 'this' I am *not* applying a predicate to it at all. (2) δηλοῦν τι again cannot mean what A.-H. takes it to mean. He evidently intends his words 'we are signifying something' to mean 'we have a meaning', 'we are making a significant statement'. But the Greek for this would rather be σημαίνειν τι; δηλοῦν τι means again 'to point something out'. T.'s contention is not that when we call an αἰσθητόν 'this' our words are without significance; he means that they have a meaning but an erroneous one. We think we are pointing out a *something*, whereas the appearance is not a τί, a *something*, but only a 'phase of' something. And it is not 'predicates' but the transitory appearances which in common life are spoken of as fire, water, and other things that 'avoid' the φάσις. Martin's translation is slightly paraphrastic, but indicates that he construed the words as I have done.

49 e 2–4. φεύγει ... φάσις. Note the humorous play on the language of the law courts which runs through the sentence, and is too elaborate not to be intentional. φάσις is here the verbal noun to φημί, and means a 'saying', 'utterance'. But Timaeus is playing on the identity in form with φάσις from φαίνω, a 'showing', hence a 'laying of information'. The pun is kept up in the verb ἐνδείκνυται, which is meant to recall the law term ἔνδειξις. φάσεις and ἐνδείξεις are forms of prosecution at Athens in which the mover begins by laying an information, as a common informer, against the defendant. So the legal suggestion is kept up in φεύγει, which technically means 'to be a defendant', and also 'to go into exile', and in ὑπομένειν, which is intended to suggest 'waiting for the judgement of a court' or 'for the execution of the sentence'. (The pledge given by one who gave bail for the appearance of a defendant in court was ἢ μὴν παραμενεῖν τὸν δεῖνα καὶ μὴ ἀπιέναι, 'that so-and-so will await judgement and not withdraw from the jurisdiction'.) The behaviour of the γιγνόμενον, which changes into something else as fast as you name it, is likened to that of a defendant to a φάσις who 'slips his bail' by retiring outside the jurisdiction before the case can come on. Tr. 'they will not face a trial but evade the issue of an impeachment of being a this or a that ... or any other indictment of permanence'. In e 3 there is a difficulty about the τῷδε. To exist τῷδε should mean to exist for, in relation to, a definite knower or percipient. But to say that γιγνόμενα will not face the trial of their claim 'to exist *for* so-and-so' is not an illustration of their impermanence. If it illustrates anything it illustrates the impermanence or unreality of the *percipient*, and that would not be relevant in the present context. The sense we want is

that sensibles may not even be said to be 'relative to a *this*', because the second term of the relation would itself be a sensible, and therefore too impermanent to be called 'this'. For example, not only must you not call the yellow you are now seeing itself a *thing*, but further you may not even say that it is a colour *of* a thing (e.g. of 'this gold'), because the 'gold' is no less mutable and perishable than the yellow. The Greek for 'relative to this' is not τῷδε but τοῦδε (*of* this). Accordingly I would write τοῦδε for τῷδε. C. W.'s τοῦ ὧδε, '*thus*', is also a possible alternative, though hardly so likely, I think, as τοῦδε, which covers *all* relation of any kind to a 'this'. A.-H. oddly translates τοῦδε, though, like other editors, he gives τῷδε in his text.[1]

49 e 4–7. ἀλλὰ ταῦτα . . . γένεσιν. As to the construction of the sentence, right down to its end at καλεῖν 50 a 4, the infinitives still depend on the ἀσφαλέστατά ⟨ἐστι⟩ of 49 d 3. There is a possible ambiguity of construction in the clause ἀλλὰ . . . λέγειν. We might construe 'one should not call the different appearances (ἕκαστα) *these*', regarding the ταῦτα as a plural to τοῦτο in the sense in which it has just been said that we must not speak of πῦρ or ὕδωρ as τοῦτο. So A.-H. and, I suppose, Martin, who writes 'Il ne faut jamais nommer à part, comme une chose distincte, aucun de ces objets'. But it would be hard to find another example in Plato of a plural to τοῦτο used in this peculiar way. Hence I think ταῦτα ἕκαστα means 'each of these expressions', viz. τοῦτο, τόδε, τοῦδε, and the like, which have just been specified, and that the sense is simply 'one should use none of these phrases'. Cf the use of τούτων in 50 a 4, where μηδὲν αὖ τούτων καλεῖν means 'to give it none of these names', viz. not to call it τοῦτο, τόδε, or the like.

49 e 5–6. τὸ δὲ τοιοῦτον . . . καλεῖν. I do not see any sufficient reason to suspect the text, which should be construed as follows, 'but ⟨it is safest⟩ in each case and in all (ἑκάστου πέρι καὶ συμπάντων to be taken with οὕτω καλεῖν, not with περιφερόμενον) to give the name to (οὕτω καλεῖν) the this-like which is perpetually turning up as similar'. The exact meaning of οὕτω καλεῖν, 'to give these names to', is made clear by the example which follows immediately. It means 'to give the names of πῦρ, ὕδωρ, λίθος', and so on to the various 'phases' or 'occurrences', not to some supposed substantial 'thing'. We might have supposed, but for the example about πῦρ, that the meaning is that we should avoid *nouns* altogether and only use adjectives, speaking not of fire, but of 'fiery' appearances, and so forth. But the example shows that T. does not propose to banish the nouns of common speech, only to make it clear that they are not to be mistaken for names of anything substantial or permanent. We are to understand, once for all, that they are names of 'sensible qualities' or groups of such qualities which 'come round' over and over again (ἀεί) in the passage of nature and are 'alike'. For περιφερόμενον A.-H. appositely cites *Theaetetus* 202 a 5 ταῦτα (viz. such expressions as αὐτό, ἐκεῖνο, τοῦτο) μὲν γὰρ περιτρέχοντα πᾶσι προσφέρεσθαι. I.e. 'this', 'that', 'it' go the round and are equally applicable to

[1] M. Rivaud, after Miss Eva Sachs, boldly replaces τῷδε by τοῦ δέν. I cannot believe that we have any right to foist on Plato this 'nonsense-word' of Democritus. Probably Democritus himself only used it once, as W. James once coined 'a thing' as antithetic to 'nothing'.

anything and everything. I do not see any real difficulty in ὅμοιον as a 'tertiary predicate' with περιφερόμενον. The meaning is that 'similar' qualities or groups of qualities are continually turning up in the course of 'passage', and that we are to give the names πῦρ and the like to these 'similars' without fancying that they are anything but similar 'episodes' in the unceasing passage. St. proposed to alter ὅμοιον to ὁμοίως, and A.-H. introduces the change into the text. But apparently they differ as to the construction. St., as his brief note shows, meant ὁμοίως to be taken with ἑκάστου περὶ καὶ συμπάντων, 'in the case of each and all equally', i.e. we call one set of similar occurrences πῦρ, another ὕδωρ, and we do the like in all cases of a group of 'similars'. A.-H. translates 'applying in the same sense to all their mutations', apparently construing ὁμοίως with περιφερόμενον. If the change were desirable at all I should think it much more natural to construe St.'s ὁμοίως as St. intended.[1]

49 e 6–7. καὶ δὴ καὶ πῦρ . . . γένεσιν. The καὶ δὴ καί introduces a particular example of the general rule just laid down, a regular use of this combination of particles. See Kühner-Gerth iv. 125. τὸ τοιοῦτον not = τὸ πυρῶδες, but 'what is of a certain quality', 'what has the quality *x*', where *x* stands for something presumed to be definite but not further characterized. καὶ ἅπαν ὁσονπερ ἂν ἔχῃ γένεσιν is equivalent to ἅπαν γεννητόν, and to be taken as grammatically parallel with πῦρ, not with τὸ τοιοῦτον, 'and to give every name of a γιγνόμενον to τὸ διὰ παντὸς τοιοῦτον, what regularly has the quality so-and-so'. I.e. you call 'what has the quality *x*' πῦρ, 'what has the quality *y*' ὕδωρ, and so on universally.

49 e 7—50 a 4. ἐν ᾧ δὲ . . . καλεῖν. So far Timaeus might seem to have gone beyond even Heraclitus in eliminating everything like permanence from nature. According to Heraclitus you could not call water or earth τοῦτο; each of them is only τοιοῦτον, a 'phase', and a passing phase, in the life of nature, and nothing more. But there still remains one τοῦτο, the 'ever-living fire'. Fire really is the stuff of which everything is made; it is that *of* which water and earth are 'phases'. H. holds that fire is 'exchanged' for earth and water, and yet, at the same time that what we call earth and water all the time *are* fire—under a disguise. It is precisely this inconsistency which roused the scorn of Parmenides for the men who could say that 'it is the same and not the same and all things are travelling on opposite paths' (*Parmen.* Fr. 6, *Fr. d. Vors.*[5] i. 153 = R. P. 115 κωφοὶ ὁμῶς τυφλοί τε, τεθηπότες, ἄκριτα φῦλα, | οἷς τὸ πέλειν τε καὶ οὐκ εἶναι ταὐτὸν νενόμισται | κοὐ ταὐτόν, πάντων δὲ παλίντροπός ἐστι κέλευθος). Timaeus, like Parmenides, objects to the inconsequence, and has been at special pains to labour the point that πῦρ is just as much a τοιοῦτον, 'a passing phase', as all the rest. Has he then reduced the whole of nature to a mere succession, change without any correlated

[1] I agree with Fraccaroli in holding that the whole of the passage from 49 d 4 to 50 a 4 has been generally misconstrued and misunderstood. But I think his own construction and interpretation also unfortunate. In construing he makes the mistake of taking the ἀεί of 49 d 4 and that of d 7 apart from the καλεῖν to which they belong, and consequently of supposing that τὸ τοιοῦτον ἀεὶ (d 6–7) could mean τὸ ἀεὶ ὡσαύτως ἔχον. So he renders the ἀεί of 49 e 5 *sempre*. In fact the ἀεί there goes with περιφερόμενον and means ἑκάστοτε. F. thus gets a contrast between 'phenomenal' and 'ideal' fire or water, which is foreign to the context. It is not with the Forms but with the ἐν ᾧ ἐγγιγνόμενα φαντάζεται that the 'appearances' are being contrasted.

permanent which can be called 'it' or 'this' without an apology for using words in a misleading way? He now explains that this was not his meaning. The 'permanent throughout change', which may properly be spoken of as 'it' and 'this', is that 'in which' the occurrences go on, the volume they fill, extension itself. Events occur in it, but it does not itself 'occur', but is just there and remains throughout the whole varied 'passage' exactly what it is. Thus extension is entitled to have ἔστι said about it, and therefore all the words like τοῦτο, ἐκεῖνο, and the like, which have been declared inapplicable to γιγνόμενα except in a Pickwickian sense, may be used of extension. The abiding something which *has* the 'fiery' quality in the cases where in ordinary language we say 'there *is* fire', the 'watery' when we say 'there is water', is the *volume* in which events of a certain type take place.

It is worth while to compare this answer to the problem suggested by change with that which had been given by Parmenides. Parmenides[1] had argued that there can be no change unless there is 'empty space' for it to go on in. But empty space is just nothing at all. Therefore change is an illusion; nothing ever really happens. This amounts to saying that if there is change in nature there must also be something permanent, but everything that is is a body; now no body can be 'the permanent implied in change', since bodies are just what undergo that change; body would therefore have to be at once that which changes and that which is unchanging, and this is unthinkable. Therefore there really is no change at all. Timaeus is a Pythagorean and, as a Pythagorean, he is a geometer, and consequently able to distinguish in thought between volume and the sensible events which go on within it. This distinction is precisely that which Parmenides never succeeded in making. If he had made it, the difficulty which had led him to deny that change is more than an illusion would have disappeared. The distinction is in the true line of development from early Pythagorean ideas, since we know that the belief in a great κενόν surrounding the world from which it 'inhales' the emptiness within it which 'keep things apart' (διορίζει τὰς φύσεις)[2] was their doctrine from the vigorous polemic of Aristotle against it. It is true, perhaps, that this κενόν was not clearly distinguished from darkness, but the idea was there, and had not to be introduced into speculation for the first time by the Atomists, whose originality has been unduly exalted because the affiliation of their views with Pythagoreanism has been forgotten. In one respect Timaeus shows himself more cautious than either the Pythagorean believers in the μέγα κενόν or their Atomist successors. There is no place in his system, which knows of only one οὐρανός, for an emptiness 'outside the world'. What he holds about 'empty' spaces *within* the world will have to be considered later when we come to the references he makes to κενά. But in his general account of the 'receptacle' he does not make the mistake of confounding the distinction between a volume and its 'filling' with the assertion that there are volumes which are without any 'filling' of events. All that he needs to provide him with a 'permanent implied in change' is that volume

[1] *EGPh.*[3] 181.

[2] Aristot. *Physica* Γ. 203[a] 6 ff., 213[a] 33, [b] 23.

and its 'filling' of events shall be distinguishable; it is not necessary that he should further maintain that there are volumes which have *no* 'filling' at all. If this is to be asserted, it will have to be for reasons of a more specific kind. Also, though the remark is anticipatory of considerations which will concern us later—if it should turn out that for special reasons we have to assume volumes which are 'empty' in the sense that no events which we can detect go on in them, it will not follow that they are pure *vacua*, empty in the further sense that nothing at all goes on in them.

50 a 3. ἢ καὶ ὁτιοῦν τῶν ἐναντίων, that is, any member of the pairs of 'opposites'—antithetical qualities, as we should call them in our more advanced terminology—which play such a prominent part in Ionian natural science, and consequently in that of Aristotle, θερμὸν . . . ψυχρόν, βαρὺ . . . κοῦφον, ὑγρὸν . . . ξηρόν, λευκὸν . . . μέλαν, and the rest. The famous Pythagorean list given by Aristotle at *Met.* A. 986ª 23 ff. is an attempt to make a table of the most important of them, ranging them all in double columns under the most important pair of all πέρας . . . ἄπειρον.

50 a 4–c 6. ἔτι δὲ σαφέστερον . . . μέτιμεν. To make his meaning clearer T. takes an illustration from the manual arts. (The frequency and wealth of such illustrations is a marked characteristic of Plato. It cannot be explained simply as reproduction of the fondness of *Socrates* for homely examples taken from 'shoemakers and fullers and carpenters', for the practice is not confined in the dialogues to Socrates, and the richest mine of such illustrations is the talk of the anonymous Eleatic in the *Sophistes* and *Politicus*. Plato was evidently keenly interested in the details of the industrial arts and a careful observer of them.) Suppose a man were to busy himself at incessantly shaping a piece of gold—a metal named, no doubt, for its softness and pliability—into one figure after another, triangular, square, and so forth, and were to ask you, while he was in the very act of doing so, 'What is this I have in my hands?' It would be safer to say 'gold' than to say 'a triangle' or 'a square', since the figure would be actually changing while you spoke. You could not safely go further than to call the shape of the moment a τοιοῦτον, a 'phase' in the history of the piece of gold. Now volume and the events which occur in it are related like the gold and the triangular, square, and other shapes in this parable. Volume is permanent; it never changes its character for the good reason that volume—the volume in which passage as a whole occurs—has *no* figure to change. All these shapes are the shapes of the 'things which come into it and go out of it', but it has no particular shape of its own. It is—and here we get a second illustration from the crafts—like an ἐκμαγεῖον or 'matrix', that is, a uniform mass of wax or other soft stuff on which you can print the different devices of innumerable seals[1] (ἐκμάττειν is the regular word for

[1] For the ἐκμαγεῖον and the underlying metaphor compare the famous passage about the block of wax in *Theaetetus* 191 c 8 ff. θὲς δή μοι λόγου ἕνεκα ἐν ταῖς ψυχαῖς ἡμῶν ἐνὸν κήρινον ἐκμαγεῖον κτλ., ib. d 7 καὶ ὁ μὲν ἂν ἐκμαγῇ, μνημονεύειν τε καὶ ἐπίστασθαι ἕως ἂν ἐνῇ τὸ εἴδωλον αὐτοῦ· ὃ δ' ἂν ἐξαλειφθῇ ἢ μὴ οἷόν τε γένηται ἐκμαγῆναι, ἐπιλελῆσθαί τε καὶ μὴ ἐπίστασθαι. The metaphor is the same at *Rep.* iii. 396 d 7 ἅμα δὲ καὶ δυσχεραίνων αὐτὸν ἐκμάττειν τε καὶ ἐνιστάναι εἰς τοὺς τῶν κακιόνων τύπους, and in

making such an impression), though the mass has no pattern or device of its own. So volume is uniform, and it is only from the events which go on in it that it seems to be figured differently in different regions, and so to be 'fire' here and 'water' there. I.e. geometrical extension is the one universal and uniform invariant which is always and everywhere the same. Descartes uses the same illustration. In the *Second Meditation* he takes for consideration a lump of beeswax which is slowly melted, and points out that as it melts every sensible quality it originally had is lost, its shape goes, it expands in size, its colour and fragrance disappear, its hardness vanishes. What then do I mean by the thing I assume to be permanent throughout the process when I say that *it* was solid but now is fluid, was fragrant but is now scentless, and so on? Descartes says that I can only mean the one character which has not changed, and that this character is that of being extended. The argument is so exactly that of Timaeus that we can hardly avoid believing that Descartes was writing with conscious or unconscious dependence on this passage of Plato.[1]

50 b 3. μηδέποτε λέγειν ταῦτα ὡς ὄντα. The trouble is precisely that to think intelligibly of change or passage, you must think of it as relative to an ὄν which does not 'pass', but what the common man calls the 'thing' itself γίγνεται, 'passes'.

Aristotle (*de Generatione* B. 329ª 13 ff.) offers an objection to the analogy between the ὑποδοχή and the 'gold' of the illustration which A.-H. seems to me not to have wholly understood. What is written in the *Timaeus*, Aristotle says, is ambiguous (ὡς δ' ἐν τῷ Τιμαίῳ γέγραπται, οὐδένα ἔχει διορισμόν). For he has not explained clearly whether the 'receptacle' is separated (*or* separable) from the 'elements' (οὐ γὰρ εἴρηκε σαφῶς τὸ πανδεχὲς εἰ χωρίζεται τῶν στοιχείων). And though he said in an earlier passage that it is a kind of substrate for what are called the 'elements', as gold is for things made of gold, he makes no use of this notion (οὐδὲ χρῆται οὐδέν, φήσας εἶναι ὑποκείμενόν τι τοῖς καλουμένοις στοιχείοις πρότερον, οἷον χρυσὸν τοῖς ἔργοις τοῖς χρυσοῖς). Indeed, the comparison itself is unfortunate (καίτοι καὶ τοῦτο οὐ καλῶς λέγεται τοῦτον τὸν τρόπον λεγόμενον). What he says holds in cases of *alteration*, but in the case of things which begin and cease *to be*, it is impossible to call them by the name of that out of which they have arisen (ὧν δὲ γένεσις καὶ φθορά, ἀδύνατον ἐκεῖνο προσαγορεύεσθαι ἐξ οὗ γέγονεν). Yet his words are that 'it is much the truest course' to call each of the things 'gold' (καίτοι γέ φησι μακρῷ ἀληθέστατον εἶναι χρυσὸν λέγειν ἕκαστον εἶναι). The *point* of the criticism is surely obvious. Aristotle holds that there is an enormous difference between ἀλλοίωσις, change of quality in something which already *is*, and γένεσις and φθορά, the 'emergence' for the first time of something which was not there before, or the 'annihilation' of something which was

Aristot. *Met.* A. 988ª 1 where the view is ascribed to Plato ἐκ τῆς δυάδος γεννᾶσθαι τοὺς ἀριθμοὺς ὥσπερ ἐκ τινος ἐκμαγείου. 'The unit' is here compared with a seal or seal-ring, the 'dyad' with the block of wax on which it is pressed.

[1] This point is raised by Robin (*Place de la Physique dans la Philosophie de Platon* 29 n. 2) who declines to express an opinion, but hints that the illustration of the 'wax' *may* come from Chalcidius (*Comment.* 309, Wrobel p. 337 'ut cera quae transfigurata in multas diversasque formas non ipsa vertitur', etc.) and reminds us that, according to Regius, the *Timaeus* had been translated into French in 1581.

there. In his own terminology, ἀλλοίωσις is a κίνησις, γένεσις and φθορά are not properly κινήσεις, since a κίνησις implies the presence of something which κινεῖται; they are μεταβολαί of a very special kind, the coming to be or ceasing to be of an οὐσία or substance. It is from this point of view that he is objecting to the illustration used by Timaeus. His point is that Timaeus professes to be explaining how πῦρ, for example, which is one of the 'so-called στοιχεῖα', 'comes into being' and 'passes out of being', and it is true that Timaeus uses language which, if pressed, does assert the γένεσις and φθορά of πῦρ and the rest, e. g. the γιγνόμενον and ἀπολλύμενον of 52 a 6–7. Consequently Aristotle makes two criticisms. (1) You would expect, from the illustration about the gold, that Timaeus would go on to say that the ὑποδοχή is a kind of *stuff*, and that what we commonly call the 'coming to be' or 'ceasing to be' of fire, water, and the like, is really only qualitative change (ἀλλοίωσις) of this permanent stuff. But he does not say this after all. He does not regard his 'receptacle' as the 'substrate' or 'stuff' of things, and he goes on to speak of a real γένεσις and φθορά of αἰσθητά. This is a perfectly correct observation. (2) Also, the illustration itself is only applicable to cases of 'alteration' of an already pre-existing 'substance'. There really is no parallel between the moulding of the same bit of stuff into different shapes and the appearance or disappearance of a 'substantial' thing. Therefore, though it is true enough that it is nearest to the truth to answer the question of Timaeus' illustration by saying 'this is gold', it does not follow that it is truer to say 'this is extension' than to say 'this is fire' or 'this is water'. From his own point of view, Aristotle's criticism is correct and intelligible. If the 'permanent in change' must be thought of as a 'stuff' or 'substrate', it clearly follows that no analogy from ἀλλοίωσις can throw any light upon the origination or destruction, the γένεσις or φθορά of a substantial thing. γένεσις and φθορά must be *sui generis*, and that was why Leibniz said of his 'monads' or 'simple substances' that they could only originate by *creation* and perish by *annihilation*. Aristotle's point is that he thinks Timaeus is trying to account for 'creation' and 'annihilation' by an analogy from 'transformation'. The pertinent rejoinder would be that Timaeus does not assume the necessity for any 'substrate' at all. The 'receptacle' is not a 'substrate' (so far A.-H.'s observations are pertinent). What Timaeus regards as necessary for change is simply a correlated 'permanent which does not change', but Aristotle is so wedded to the thought of this permanent as a 'substrate' or 'stuff' that he cannot enter sympathetically into any view which finds it in anything else. The object of the passage into which he introduces these remarks is to argue that the 'substrate' or 'matter' which remains the same throughout change cannot be supposed to exist actually by itself. It *underlies* all the 'so-called στοιχεῖα', but it is never found except as exhibiting the specific qualities of one or other of them. There can be no actual σῶμα αἰσθητόν which does not exhibit some of the 'opposites' to the exclusion of others, and, he argues, the 'receptacle' of Timaeus, which is not a σῶμα αἰσθητόν, is so vaguely conceived that one can make nothing of it. So he goes on to say in his actual analysis of bodies Timaeus is content to start with ἐπίπεδα, plane

figures; he does not attempt to analyse the plane figures (the triangles of which we are to hear) further, and to show how they can be said to be related to the formless 'receptacle' as the golden figures of the illustration are to the gold.

50 c 1. *τῶν εἰσιόντων.* There does not seem to me to be much difficulty in saying what these *εἰσιόντα* and *ἐξιόντα* are. As the expression *τῶν ὄντων μίμηται* applied to them at c 5 shows, they are just what Timaeus has all along called *μιμήματα*, the *γιγνόμενα* or events of the passage of nature, actual sensa, what the plain man calls 'things'. They 'come and go', not in the sense that they come 'into' space from somewhere 'outside' space, or 'go out' of it to somewhere 'outside' it, but in the simple sense that they appear at a given region and vanish again, are, as the proverbial phrase puts it, 'here to-day and gone to-morrow'. A.-H. virtually identifies them with 'forms' in Aristotle's sense, 'forms' which can be distinguished from but do not exist 'apart from' the 'matter' to which they give structure. This, however, cannot be right, since Timaeus has expressly told us that he needs only three terms with which to work in this theory, the *παραδείγματα*, the *ἐκμαγεῖον*, and the copies of the *παραδείγματα*, and we have no right to smuggle in an unmentioned fourth term. It is true that Plato himself did recognize a class intermediate between his Forms or Numbers and sensible things—the so-called 'mathematicals', but the 'mathematicals' must not be confused with Aristotelian 'forms', since it is a standing criticism of Aristotle on Plato that they, as well as the Forms, were supposed to be 'separate' (*χωριστά*) from the 'sensibles'. And the doctrine should not be looked for in the *Timaeus*, as Timaeus is a Pythagorean, and Aristotle expressly insists on the point that the 'separation' of 'mathematicals' from both Forms and 'sensibles' was one of the points which distinguished Platonism from Pythagoreanism (*Met.* A. 987^{b} 27 *ὁ μὲν τοὺς ἀριθμοὺς παρὰ τὰ αἰσθητά, οἱ δ' ἀριθμοὺς εἶναί φασιν αὐτὰ τὰ πράγματα, καὶ τὰ μαθηματικὰ μεταξὺ τούτων οὐ τιθέασιν*).

50 c 6. *ὃν εἰς αὖθις μέτιμεν.* The words are, as elsewhere in Plato (see the passages cited in Ast *Lexicon Platonicum* s.v. *εἰσαῦθις*), a mere polite formula for the dismissal of a subject, like our 'another time'. They do not promise a fuller discussion. A.-H. is certainly wrong in supposing an allusion to 52 c, where the question what the 'mysterious fashion' in which the *μιμήματα* are 'offprints' of *ὄντα* is is not raised at all. *What* this is was just the supreme problem of Plato's own philosophy, and from Aristotle's allusions, when he speaks of it, to the *ἄγραφα δόγματα*, it would appear that Plato, so far as he gave a solution of it, only gave it in the famous 'unwritten lecture' on the Good to which Aristotle appeals as his authority. The most important passage in Aristotle about the whole subject is *Met.* A. 987^{b} 18 ff.: 'Since the Forms are causes of everything else, he held that their primary constituents (*στοιχεῖα*) are the primary constituents (*στοιχεῖα*) of all things (*τῶν ὄντων*). Now these principles (*sc.* the *στοιχεῖα* of the Forms) are as matter the Great and Small, as formal principle (*οὐσία*) the One. For the Numbers, i. e. the Forms, arise from the Great and Small by participation in the One' (*ἐπεὶ δ' αἴτια τὰ εἴδη τοῖς ἄλλοις, τἀκείνων στοιχεῖα πάντων ᾠήθη τῶν ὄντων*

εἶναι στοιχεῖα. ὡς μὲν οὖν ὕλην τὸ μέγα καὶ τὸ μικρὸν εἶναι ἀρχάς, ὡς δ' οὐσίαν τὸ ἕν. ἐξ ἐκείνων γὰρ κατὰ μέθεξιν τοῦ ἑνὸς τὰ εἴδη εἶναι τοὺς ἀριθμούς). From other rererences to the lecture on the Good we can see that the problem *how* things 'arise from Forms' was what the discourse dealt with. As it is so often called 'unwritten', we may infer that Plato never set down any formal statement of his solution, and this explains why so many of the leading members of the Academy 'published' their notes of the lecture. A few extracts from these notes have been preserved by the commentators on Aristotle, but they do not tell us much more than what Aristotle himself says in the sentence just quoted. We may be sure that Plato did not mean to put into the mouth of a speaker in a dialogue thoughts which his own pupils were only allowed to learn from one very difficult lecture which was never set down in writing. In a study of the philosophy of Plato it would be necessary to examine all these references to the doctrine of Form-Numbers minutely; the subject is really irrelevant to the interpretation of the *Timaeus*. (The one satisfactory full discussion of it is the exhaustive and admirable work of L. Robin *La Théorie Platonicienne des Idées et des Nombres d'après Aristote*, Paris, 1908.)[1]

There is a *general* similarity between the kind of theory expounded by Timaeus and what Aristotle tells us about Plato's views. The world of sense is described by Timaeus as involving two ἀρχαί, the παραδείγματα and the ὑποδοχή, and the ὑποδοχή, Space, is in fact *a* great-and-small or continuum, because between any two different magnitudes of volume, however near together, you can insert an infinite number of intermediate volumes. But Timaeus says nothing about the *continuousness* of the ὑποδοχή, the point Aristotle insists upon as distinctive of Plato (*Met.* A. 987^{b}25 τὸ δ' ἀντὶ τοῦ ἀπείρου ὡς ἑνὸς δυάδα ποιῆσαι καὶ τὸ ἄπειρον ἐκ μεγάλου καὶ μικροῦ, τοῦτ' ἴδιον). As Tannery and Bt. in particular have shown, the great crisis in the middle of the fifth century which led to an apparent 'bankruptcy of science' was due to the fact that the Pythagorean mathematicians had at bottom treated spatial quantities, the line, &c., as though they were discontinuous, like the series of integers, and were thus unable to give any intelligible account of the 'surd' quantities which proved to be so common in geometry. It was this which gave an opening for Zeno's polemic against Pythagorean science, and in the next century compelled Eudoxus to recast elementary mathematics into the form in which we find it in the *Elements* of Euclid, where plane geometry and the doctrine of proportion are placed before and treated independently of the theory of number. In making the ἄπειρον expressly a continuum Plato showed that his science was that of the fourth and not of the fifth century. Hence he could not, without anachronism, put his own views about the ἄπειρον into the mouth of Timaeus. Hence, though Timaeus is not allowed to say anything inconsistent with the continuity of the ὑποδοχή, he is never allowed to say in so many words that it *is* a 'great-and-small'. He treats it, in the way Aristotle regarded as distinctive of Pythagoreanism, as ἔν τι, never as a δυάς. This ought to make us very careful how we allow ourselves to attribute any of the theories of Timaeus,

[1] [But reference may also be made now to Stenzel, *Form und Gestalt bei Platon und Aristoteles* (Leipzig, 1924) and to my own essay *Forms and Numbers* in MIND, *n.s.* 140.]

as they stand, to Plato as expressions of his own thought, unless we can prove that they are so, e. g. by parallels in the *Laws*. It is even more important that we learn from Aristotle that Plato further taught that the Forms themselves, the παραδείγματα of the *Timaeus*, have two ἀρχαί, the One and the Great-and-Small, so that there is a still more ultimate continuum than space; of this, which Aristotle regards as the most important point of originality in Platonism, Timaeus gives us no hint.

50 c 7—51 a 3. ἐν δ' οὖν . . . εἰδῶν. Since the ὑποδοχή is to receive impartially all sorts of determinations, it can have no distinctive 'figure' of its own, otherwise this would cause some of the 'offprints' of the 'models' to be distorted. We may illustrate this by another example from industry. Perfumers are specially careful that the liquid which is to be the 'vehicle' of the different scents they manufacture should be scentless. If the liquid had any scent of its own, this would interfere with the purity of the scents it is proposed to introduce into it. So also the man who wishes to fit a soft surface for the reception of a design begins by making it as smooth as it can be made. Thus we see that the permanent implied in change must itself have none of the 'forms' the succession of which makes up the 'passage' of nature.

50 c 7. ἐν δ' οὖν τῷ παρόντι. The δ' οὖν resumes the main thread of the statement. The words may be taken as the most distant of hints that Timaeus is aware that he is leaving unsolved a problem which it might be important to examine in another connexion. We could not infer from the words even that *Plato* had a solution; they only amount to a recognition that the last word is not being said.

50 d 7. ἄμορφον . . . ἁπασῶν τῶν ἰδεῶν. There is here nothing technical about the use of this word or of εἰδῶν in the same sense at 51 a 3. It is as general as, or more general than, our 'figure'. From 51 b 4–5 we see that the 'figures' of which Timaeus is thinking are, in the first instance, the characteristics of the different sensible bodies, in fact the various sounds, colours, scents, &c., revealed to us in different regions, and that is why space is said to 'receive' them. They are identical with the ἐξιόντα and εἰσιόντα of which we have already heard. But since Timaeus means at a later stage to account for all these qualities as consequences of the shapes of corpuscles, to all intents and purposes what he wants to insist on is that space itself has no specific 'shape' of its own. He means, then, that space in all its regions is uniform or homogeneous. If it were not, its parts would not be indifferent to *all* configurations. Some could not exist without distortion (κακῶς ἂν ἀφομοιοῖ 50 e 3), its own figure would show through the pattern imprinted on it (τὴν αὑτοῦ παρεμφαῖνον ὄψιν 50 e 4). He means that the *res extensa* is of the same make all over. He clearly would have had no sympathy with the way in which W. K. Clifford and other physicists have played with the notion of a non-uniform space with different formal properties in different regions. (See e.g. Clifford and K. Pearson *Common-sense of the Exact Sciences*, c. 4, § 19, 'On the Bending of Space'; Helmholtz *Popular Scientific Lectures* [E. Tr.] ii. 27–71, 'On the Origin and Significance of Geometrical Axioms'; Einstein *Theory of Relativity* [E. Tr.] 113–14; Eddington *Space, Time, and Gravitation* (10, 11).) Dr. Whitehead,

fully agreeing with Timaeus, asserts as against Einstein and some of his followers the 'essential uniformity' of space, and it is not the least merit of his philosophy of nature that he has been able, so far as a mere student of philosophy can see, to state the physical doctrine of relativity in a way which does not involve the enormous difficulty of ascribing a 'variable curvature' to space (*Concept of Nature*, Preface, p. vii). The question of the uniformity or non-uniformity of space is not the same as that raised when it is asked whether 'space is Euclidean or non-Euclidean'. In the 'hyperbolic geometry' of Lobachevsky and Bolyai, and again in the 'elliptical geometry' of Riemann or Klein, no less than in Euclid's, space is assumed to be uniform all over and all through. There is a difference between the sets of postulates assumed in the three types of geometry which can be *metaphorically* expressed by saying that the 'curvature of space' in Euclid's system is zero, in Lobachevsky's and Bolyai's constant and negative, in Riemann's or Klein's constant and positive. But the expression 'curvature of space' is purely metaphorical, and in all three geometries, the 'curvature' is assumed to be the same for all regions of space.[1] A space with varying curvature or non-uniform space would mean one in which the postulates which held for some regions would not hold for others. Obviously the question whether different sets of postulates are required for different regions is much more fundamental than the question whether a particular postulate (the famous 5th postulate of Euclid) should be included in the list, or if not, what should take its place. All that Timaeus says here is that space is uniform, not that it is 'flat' or 'Euclidean'.

50 e 1–4. **ὅμοιον γὰρ ὂν . . . ὄψιν.** The argument seems to be in Aristotle's mind in more than one passage of the *de Anima*. As A.-H. says, he seems to be thinking of it in the famous chapter (*de Anima* Γ. 4, 429ᵃ 10 ff.) where he teaches that νοῦς, 'the part (μόριον) of the ψυχή with which it cognizes both theoretical and practical truths (ᾧ γινώσκει τε ἡ ψυχὴ καὶ φρονεῖ) is δυνάμει, "potentially" the same as the objects it knows (τὰ νοητά), but actually is not any one of them "before it thinks them". In *de Anima* B the same doctrine had been laid down about the relation of sensation to the sensibles it discerns. Sense is 'potentially' the whole range of the sensibles of which it can be aware (sight, for example, is 'potentially' the whole range of colour), but is not actually any one of them except at the moment of the actual sensation (418ᵃ 3 τὸ δ' αἰσθητικὸν δυνάμει ἐστὶν οἷον τὸ αἰσθητὸν ἤδη ἐντελεχείᾳ, καθάπερ εἴρηται. πάσχει μὲν οὖν οὐχ ὅμοιον ὄν, πεπονθὸς δ' ὡμοίωται καὶ ἔστιν οἷον ἐκεῖνο). At B. 424ᵃ 17 this leads to the famous definition, framed with an allusion to the wax block and the signet of the *Theaetetus*, that sense is 'that which receives the forms of sensibles without their matter, as the wax

[1] Cf. the observation of Weyl *Space, Time, Matter* (E. Tr. p. 98): 'Riemann rejects the opinion that had prevailed up to his own time, namely, that the metrical structure of space is fixed and inherently independent of the physical phenomena for which it serves as a background, and that the real content takes possession of it as of residential flats. *He asserts, on the contrary, that space in itself is nothing more than a three-dimensional manifold devoid of all form; it acquires a definite form only through the advent of the material content filling it and determining its metric relations*'.

receives the device on the signet without the gold or iron (of which the ring is made), *ἡ αἴσθησίς ἐστι τὸ δεκτικὸν τῶν αἰσθητῶν εἰδῶν ἄνευ τῆς ὕλης, οἷον ὁ κηρὸς τοῦ δακτυλίου ἄνευ τοῦ σιδήρου καὶ τοῦ χρυσοῦ δέχεται τὸ σημεῖον.* It follows from this theory that the real organ, e.g. of vision, can have no inherent colour of its own, since, if it had, this inherent colour would interfere with the correct apprehension of all others. If the organ of vision were e. g. itself 'red' it could not have at once the 'form' of red and also the 'form' of the green thing at which we are looking, and this is why Aristotle makes a point of it in the *de Sensu* that both the organ of vision and the medium of colour-vision are themselves 'transparent', i.e. uncoloured (otherwise we should be like persons compelled to view everything through tinted glasses). In *de Anima* Γ the argument is repeated about *νοῦς* in language clearly coloured by recollections of the present passage. *νοῦς* apprehends all the *νοητὰ εἴδη*, the intelligible laws, inherent in nature, and therefore none of them can be the form or law of *νοῦς* itself. If you ask what *νοῦς is*, considered apart from its action as apprehending the truth of science, you can only say that it is a 'capacity' for apprehending them all, but is actually none of them (*429*[a] 15 *ἀπαθὲς ἄρα δεῖ εἶναι, δεκτικὸν δὲ τοῦ εἴδους καὶ δυνάμει τοιοῦτον ἀλλὰ μὴ τοῦτο, καὶ ὁμοίως ἔχειν, ὥσπερ τὸ αἰσθητικὸν πρὸς τὰ αἰσθητά, οὕτω τὸν νοῦν πρὸς τὰ νοητά. ἀνάγκη ἄρα, ἐπεὶ πάντα νοεῖ, ἀμιγῆ εἶναι, ὥσπερ φησὶν Ἀναξαγόρας, ἵνα κρατῇ, τοῦτο δ' ἐστὶν ἵνα γνωρίζῃ· παρεμφαινόμενον γὰρ*—an echo of T.'s *τὴν αὐτοῦ παρεμφαῖνον ὄψιν*—*κωλύει τὸ ἀλλότριον καὶ ἀντιφράττει*). Hence, he says, *νοῦς* is *οὐθὲν ἐνεργείᾳ τῶν ὄντων πρὶν νοεῖν* (ib. *429*[a] 24). The meaning is that there are no actual 'innate ideas', and that the mind has no *a priori* 'categories' of its own which it imposes from its own stock upon the experienced world. If it had it would not reflect the 'nature of things' faithfully, but would distort them or discolour them as a coloured glass misrepresents the colours of the things seen through it. Mr. B. Russell has criticized Kant's theory of the nature of the *a priori* principles implied in science, which he interprets apparently as a piece of psychology, in exactly the same spirit. (*Problems of Philosophy* p. 133 ff.)

50 e 4—51 a 1. διὸ καὶ πάντων . . . ἀπεργάζονται. (Note the absolute equivalence in Plato's language of *εἶδος* and *γένος*. The *γένη* of e 5 are identical with the *εἴδη* of the line before.) The bearing of Timaeus' insistence on the 'formlessness' of the *ὑποδοχή* is that, if we recognize the uniformity of space in the sense already explained, we are not allowed to account for exceptional 'appearances' in any region, as those who think of space as having a variable curvature would like to do, by suggesting that this region has a 'different' geometry from others; we must look for a *physical* explanation in the specific character of the *events* which are going on in the region in question. For the illustration from the method of perfumers who are careful to begin their operations by making the vehicle which is to be impregnated with the various scents itself scentless, cf. *Rep.* iv. 429 d–e, where use is made of the similar point that dyers take great pains that the stuff which is to receive the dye shall be white—i. e. colourless—to begin with.

50 e 5–8. καθάπερ . . . ὁσμάς. The unspecified subject of *μηχαν ῶνται*

'they contrive', is οἱ μηχανώμενοι, 'those who are concerned in the procedure', the manufacturers of scents. ποιοῦσιν . . . ὀσμάς being a mere 'epexegesis' of the preceding clause, follows it, as usual, without any connecting particle. ὁπόσα εὐώδη are nominative, and we 'understand' ἐστί.

51 a 1. τῶν πάντων ἀεί τε ὄντων. This can hardly be correct. A.-H. suggests that τε perhaps has a quasi-restrictive force, so that the words mean 'all things—that is to say, all which are eternal'. But no such sense of τε seems to be known anywhere else, nor any resembling it. St. recommended omitting τε, though he did not venture to follow his own advice when he issued his Tauchnitz text. This seems also inadmissible, as the difficulty would be to explain how the τε should ever have been obtruded on so simple a phrase. And for a different reason I think it is probably the πάντων which is the corrupt word. According to normal idiom τὰ πάντα ἀεὶ ὄντα should rather mean 'whatever at any moment is' (ἀεί = ἑκάστοτε, 'from time to time') than τὰ ἀιδια, 'what *always* is'. But this latter must be the sense here. Of the emendations noted by Bt. I should prefer the 'anonymous' substitution of νοητῶν for πάντων. This would remove the awkward ambiguity about the meaning of ἀεί, and it seems to me possible that the πάντων might arise from an accidental repetition of the preceding letters TATΩN, and, having once got into the text, extrude the genuine adjective following. C. W.'s suggested insertion of νοητῶν after πάντων does not seem to me very desirable. For the sense, πάντων is superfluous if you have νοητῶν. (Can πάντων be a misreading of νοητῶν itself, which has got into the text by the side of the genuine word?)[1]

51 a 4–b 6. διὸ δὴ . . . δέχηται. The permanent 'receptacle', then, cannot be a sensible body, nor a compound of such bodies, nor an ingredient in them. It is invisible and formless and indifferent to its filling (πανδεχές), and is apprehended not through sense but by thought, though in a way which it is very hard to understand. The nouns by which we name what are commonly taken for bodies are really names for regions of it in which events of various quality are going on.

51 a 4. γεγονότος. The word is inserted in order to suggest the argument 'all αἰσθητά are γεγονότα, the permanent implied in change cannot be a γεγονός, *ergo* it is not an αἰσθητόν'. From this follow at once the two further conclusions (*a*) it is not a body of any kind, (*b*) it must be a νοητόν of some sort.

51 a 5–6. μήτε γῆν . . . λέγωμεν. This cuts at the roots of all the early cosmologies which made one or more sensible bodies the permanent reality implied by change, Thales (water), Anaximenes (ἀήρ), Heraclitus (πῦρ), Empedocles (all four together). It would also tell against that dualism of the 'light' and the 'dark' attacked by Parmenides in the second part of his poem, and apparently held by the Pythagorean contemporary with Parmenides in his younger days.

51 a 6. μήτε ὅσα ἐκ τούτων. This can hardly mean anything but 'composites of these bodies'. But whose doctrine does Timaeus intend to

[1] Fraccaroli's view that πάντων ἀεί τε ὄντων is grammatically on the same footing as πολλὰ καὶ καλά hardly calls for refutation.

censure? Perhaps he is thinking of the 'seeds' of Anaxagoras. These could not be very accurately spoken of as made *of* fire, earth, &c.; but as every 'seed' was supposed to have all the 'opposites' in it, we could understand such a way of speaking of the theory, and the singular Epicurean misunderstanding of it must have arisen from some such *façon de parler*. See on the real meaning of the doctrine *EGPh.*[3] 263–5.

51 a 6. μήτε ἐξ ὧν ταῦτα. As ταῦτα . . . ταῦτα are the σώματα αἰσθητά, fire, earth, &c., so the ἐξ ὧν ταῦτα means 'what fire, earth, &c., are made of'. The plural ὧν shows that the reference cannot be to the ἄπειρον of Anaximander. Thus Timaeus must be referring to the geometrical figures—the triangles in fact—out of which on his own theory the corpuscles of fire, &c., are constructed. He means to say that the *res extensa* not only has none of the sensible qualities of bodies, but has no 'contour' of its own.

51 a 7. ἀνόρατον εἰδός τι. The words mean no more than ἀνόρατόν τι, 'something invisible'. Compare the frequent use of εἶδος (or ἰδέα), or of φύσις, which in one of its meanings is equivalent to εἶδος, with the genitive as a mere periphrasis. E. g. *infra* 53 c 5 τὸ δὲ τοῦ σώματος εἶδος πᾶν καὶ βάθος ἔχει, 'all bodies have depth'; *Rep.* v. 475 b 4 ὃν ἄν τινος ἐπιθυμητικὸν λέγωμεν, παντὸς τοῦ εἴδους τούτου φήσομεν ἐπιθυμεῖν, i.e. simply 'when we call a man *philo-so-and-so*, we mean that he has a passion for *so-and-so* as a whole' (εἶδος does not here mean 'kind'); *Meno* 72 c 7 ἓν γέ τι εἶδος ταὐτὸν ἅπασαι ἔχουσι δι' ὃ εἰσὶν ἀρεταί, 'have a *something* in common'; *Rep.* ii. 380 d 3 ἀλλάττοντα τὸ αὑτοῦ εἶδος εἰς πολλὰς μορφάς, 'changing himself into many forms'; *Tim.* 42 d 2 πρὶν . . . εἰς τὸ τῆς πρώτης καὶ ἀρίστης ἀφίκοιτο εἶδος ἕξεως, 'until he should return to the first and best state'; 75 a 6 τὸ τῆς γλώττης εἶδος = 'the tongue'; *Rep.* ii. 389 b 4 χρήσιμον ὡς ἐν φαρμάκου εἴδει, 'useful as a medicine', *et simm.* It is not meant that the ὑποδοχή itself is one of the εἴδη which Timaeus calls παραδείγματα; there are no μιμήματα of it, and it is carefully distinguished from both παραδείγματα and μιμήματα, as a third precondition of the existence of nature, but it is a 'somewhat'. One might perhaps say that just as the fundamental error of the φυσικοί had been to regard this 'somewhat' as a *body* of some kind, the fundamental error of Parmenides had been that because he said that it could not be a body, he denied that it was anything at all. It was a mere word which looks as if it were a name, but is really not the name of anything. It is just that to which 'mortals' have given a name, 'which they should not have given'. (Parm. Fr. 8, *Fr. d. Vors.*[3] i. 158 = R. P. 121 μορφὰς γὰρ κατέθεντο δύο γνώμας ὀνομάζειν, | τῶν μίαν οὐ χρεών ἐστιν.) The words in which Timaeus tries to describe the ὑποδοχή recall Anaximander's conception of his primary body as a 'boundless' something not exhibiting any of the 'opposites' just because they are all equally present in it. (Theophrastus Περὶ φυσικῶν δοξῶν Fr. 2, *Doxogr.* 476 = R. P. 16.) It is precisely by the 'sorting out' of selections from the 'opposites' that things of determinate quality arise within the 'boundless'. (Theophr. *loc. cit.* οὗτος δὲ οὐκ ἀλλοιουμένου τοῦ στοιχείου τὴν γένεσιν ποιεῖ, ἀλλ' ἀποκρινομένων τῶν ἐναντίων διὰ τῆς ἀιδίου κινήσεως.) We shall meet in Timaeus' own theory with precisely this very 'everlasting motion' by which according to Anaximander the 'opposites' get

sifted, and this is a strong reason for holding that the doctrine of the ὑποδοχή is ultimately a refinement upon Anaximander's 'boundless body'. For the rest of the considerable evidence that the Pythagorean cosmology, and particularly the theory of the κενόν, is a development from the views of Anaximander and Anaximenes, see *EGPh.*[2] 108–11, 189. The process of derivation is something like this. Anaximenes identified the 'boundless body' of Anaximander with ἀήρ, the dark thing which was supposed to be at once 'night' and mist or cloud. Then the Pythagoreans further identified this with the 'space' of which the triangles, squares, &c., they studied in their mathematics are 'configurations'. They thought of the bodies of the visible world as shapes which light carves out of this uniform dark mist. T. is consciously, I think, recalling the language Anaximander had used about the 'boundless'. He means that although Anaximander was wrong in thinking of the permanent implied in change as a body, he was more nearly right than Anaximenes. He was right in holding that it is not characterized by a selection of 'opposite' characters (it is not e.g. any more dark and cold than it is hot and bright, and so, of course, it is not ἀήρ). It is just because it is so hard to get men to think of extension as distinguished from its 'filling' of events that T. calls the 'invisible something' δυσαλωτότατον. How difficult the task is we see even in our own day from the unwillingness of some eminent physicists to conceive of events as going on at all without a 'medium', looked on as a physical reality, for them to go on in, though admittedly no one can tell you anything about this medium beyond the bare assertion that it is that in which the events go on.

51 a 7–b 1. μεταλαμβάνον δὲ ἀπορώτατά πῃ τοῦ νοητοῦ. I.e. extension as such cannot be apprehended by the senses but only by thought. As we have been told, extension itself has no quality and no configuration, but is ἄμορφον. What we *see* is this or that coloured patch, i.e. extension + configuration + colour. Extension as such therefore is not seen because you can only see the particular coloured surface, which has contour and sensible colour-quality. Extension itself is a 'universal', and can only be grasped in thought. This is what is meant by saying that it 'partakes of the intelligible'. This participation is said to be very 'puzzling' for an equally simple reason. You cannot say what the ὑποδοχή is except by means of negatives. Commonly you can specify the positive character of νοητά. You can say e.g. that a square is 'a rectilinear figure with straight sides all equal to one another and with its angles right angles', a man is ψυχὴ σώματι χρωμένη, and so on. But, as we have just learned, the very reason why the ὑποδοχή cannot be a body is that it has no quality or configuration of its own, though without it bodies would not have the qualities and configurations we perceive them to have. Hence it follows that the ὑποδοχή itself, unlike the ordinary universals of science, can only be described by negatives. Aristotle would say that this shows that what we are trying to describe is only a 'potentiality'—the abstract possibility of the existence of mutually incompatible figures, such as triangle, square, circle. But Timaeus makes no use of the distinction between the possible and the actual. He takes the ὑποδοχή to be at least as actual as the μιμήματα or ἐκτυπώματα which

appear in it. Perhaps we might express his thought by saying that extension is a character of characters. It is not hard to discover that pennies, shillings, shirt-buttons, counters, in spite of the differences between them, have one thing in common, their round shape, and to think of this round shape itself, apart from the various points in which things with a round shape differ. . This is not hard, because we simultaneously learn to recognize other shapes, triangular, square, and the like, and to detect a positive peculiarity of the round shape which belongs to none of the others (that which is used in *defining* the circle of Euclid, for example). It is much harder to go on to discover that all the geometrical universals, 'circle', 'triangle', and the rest are determinations of something which is common to them all, and when we try to say what this something is we find ourselves driven back on language which only tells us what it is *not*. This is, I think, what Timaeus means. If you think the point out a little further, what it comes to is this. Extension is the continuum implied in the existence of geometrical figures. But you cannot explain what is the peculiarity of *this* special continuum by indicating some specific property of it. You can only explain how the continuum implied in geometrical figures differs, e.g. from the continuum implied in the existence of different colours by reference to the characters of the special 'elements' of each continuum. You have to say 'extension' is the continuum which is implied in the existence of round and square, 'colour' is the continuum implied in the existence of red and blue. Neither continuum can be specified and distinguished from the other by reference to a 'character' of itself, but only by reference to the 'characters' of its 'elements'. (Colour has no hue, as extension has no shape.) If you do try to make either continuum the subject of an ordinary subject-attribute proposition, you find that your proposition must be negative in order to be true and significant. Thus it seems to me that the difficulty Timaeus discovers in thinking of extension is really of a more general kind than he supposes. It is in fact inherent in rising to the thought of any continuum as distinguished from the thought of its 'elements', the universals of the lowest order in which the continuum in question is implied. But we are here travelling beyond any meaning of which we can suppose T. himself to be conscious.

51 b 2–6. καθ' ὅσον . . . δέχηται. This gives us the conclusion to which the whole of the argument since the end of 48 has been leading up. The ὑποδοχή is hard to describe accurately, and we are made to feel that Timaeus is not over well satisfied with the attempt he has made to characterize it. But we may at least see now what is really meant by the substantives which are commonly used as names of bodies. By fire we mean 'at any given moment' (ἑκάστοτε) a region of the ὑποδοχή where the '*phenomena* of combustion' are recognized (note the φαίνεσθαι), by water a region where we have found the *appearances* of liquidity, and so forth. Timaeus thus seems to be adopting a 'phenomenalist' account of the corporeal world, but it must be noted that he arrives at it by treating the ὑποδοχή itself as non-phenomenal. The continuum does not itself 'appear', it is implied in 'appearances'. His main point is simply to insist that none of the appearances which we call bodies is the

permanent implied in passage; the 'bodies' are 'what passes', the continuum which does not appear is the permanent.

51 b 6—52 c 8. λόγῳ δὲ δὴ . . . δύο γενήσεσθον. The result just reached leads us to explain our position on an ultimate philosophical issue. Could the three factors we have postulated for the explanation of appearances, the *παραδείγματα*, the *ὑποδοχή*, the 'events', be reduced to two? If this is to be done at all, it is clear how the reduction must be effected. We have just seen that the *ὑποδοχή* is the 'continuum implied in change'. Hence we must at least retain the *μιμήματα* or events and the *ὑποδοχή* in any coherent account of the sensible world. But need we retain the *παραδείγματα*? We made them a part of our initial 'hypothesis' at 29 a, where it was taken for granted that the *οὐρανός* is an *εἰκών* of something. But an initial assumption is not necessarily sacrosanct, and it is in accord with the theory of method expounded in the *Phaedo* to go back on it and ask whether it might not be simplified. In fact, Socrates tells us in *Rep.* vi. 510 c—511 d, that it is just the business of 'dialectic' to make us go back on and criticize all the *ὑποθέσεις* which we—rightly for our purpose at the time—assumed as postulates while we were engaged in our preliminary studies. In *Rep.* vii. 533 c 8, where he is giving us his own commentary on his declaration, he even speaks of it as the work of 'dialectic' to 'destroy' or 'do away with' these *ὑποθέσεις* (*οὐκοῦν . . . ἡ διαλεκτικὴ μέθοδος μόνη ταύτῃ πορεύεται, τὰς ὑποθέσεις ἀναιροῦσα κτλ.*). So that Timaeus is quite in order in asking whether, on revised consideration, the *ὑπόθεσις* that what we perceive by sense is always an 'image' or 'shadow' of something might not be dispensed with. Are 'fire' and 'water' and the like—he takes these examples for the reason that the question we have been discussing just before was what we really mean when we talk of 'fire' and 'water'—'images' of anything? Is there such a thing as '*just* fire', 'fire by itself' (*πῦρ αὐτὸ ἐφ' ἑαυτοῦ*), or is there nothing at all except just the 'fire' we *see*, the sensible events apprehended by a particular percipient at a particular place and time? And the same question will apply to 'all the things about which we are perpetually saying' that they are 'just' so-and so? This amounts to asking whether the standing great 'postulate' of Socrates in Plato, that there are 'Forms' is true, or was Protagoras right in saying that 'what appears to me *is* to me', i. e. that the actual sensations of any one man are *for him* and *just so long as he has them* an absolute standard of truth? It had been argued at length in the *Theaetetus* that this alternative view amounts to the doctrine that there is strictly no meaning at all in asking whether a given statement is true unless you specify a person for whom and an occasion on which it is to be pronounced true or false. 'Is this true?' will of itself be as meaningless a noise as 'Is this greater than?' Even 'Is this true *now for Socrates*?' will only mean 'Is Socrates now thinking that this is true?' The phrase 'Socrates is now thinking that this is true, but he is mistaken' will have no meaning at all. The wording of the clause *ἢ ταῦτα ἅπερ καὶ βλέπομεν . . . ἀλήθειαν* (c 1–3) suggests strongly that Timaeus actually has the Protagorean formula in his mind. Cf. the exposition given of it by Socrates and at once accepted by Theaetetus (so that it was clearly the generally accepted interpetation),

at *Theaetetus* 152 a 6–c 6, which ends with the summary αἴσθησις ἄρα τοῦ ὄντος ἀεί ἐστιν καὶ ἀψευδὲς ὡς ἐπιστήμη οὖσα. Timaeus has come so near the doctrine in his last assertion that by πῦρ we mean a certain 'appearance', that he may well feel it necessary to indicate the difference between his own doctrine and that of Protagoras.

The question at issue can be made quite clear without using any of the particular technical terms about εἴδη and μέθεξις which do so much to obscure the point for us. The question is whether there is or is not a standard of scientific truth by which individuals can and *ought* to correct the deliverances of their senses. However much we may believe that the physical world is the world our senses reveal and not any supposed unperceivable 'reality behind the veil of appearances', it is always possible, since the deliverances of my senses at a given moment are only fragmentary and are affected by the state of my own body, that they may give rise to misinterpretation, and science is based on the assumption that the *truth* about the world is that account of it which would explain *all* the appearances (including the 'illusory' ones), as one coherent logically connected system. This is the sense in which it is clearly subversive of science to assert that 'the real is just what I see and feel'. There could be no science if it were true that the real is what I see and feel just as I see and feel it, neither more nor less.[1]

The way in which the remarks about fire, water, and the like lead to the raising of the question is this. It has just been said that when we say that fire is existent we mean that there is a certain appearance in some region of the spatial continuum. The implication is that fire means the occurrence of events with some *definite* law or pattern in a region of the continuum, water the appearance of events of a different determinate pattern. It follows at once that only when this pattern is exactly realized do you have 'real' or 'pure' fire or water. If it is only imperfectly realized, you have not 'pure' fire or water, just as we should say that 'water' which proved on analysis not to be composed of hydrogen and oxygen in the proportions determined by the chemists is not 'pure' water but has 'impurities'. Now a man who holds that the deliverances of his senses at a given time and place are an ultimate standard of truth is bound, if he is logical, to say that it is nonsense to talk about e.g. 'pure water', or to ask what its exact composition is. What the *percipient's* senses cannot discriminate from water or air *is*, on this theory, water or air; there is no sense in asking whether it contains imperceptible impurities. It is explained in the *Theaetetus* that the utmost admission possible to a consistent Protagorean is that some beliefs are more *useful* than others. (If I believe that stagnant ditch-water has no impurities in it and therefore proceed to drink it, I may die from typhoid, and so my opinion about ditch-water has brought harm to me, but it cannot be said that the belief was false.) Such a theory really amounts to holding that exact science is a simple delusion, and as Timaeus is just going on to

[1] The view rejected by Timaeus, that we could do in science with only two terms, the series of events and the continuum in which the events go on is, in fact, precisely that of Mach, Avenarius, Pearson, which has been summed up in the formula that science is a 'shorthand' notation for the 'routine of our perceptions'.

propose, as the most probable hypothesis, an exact theory about something which is certainly not directly perceptible, viz. the molecular structure of the 'four roots', he needs to discuss a view about the scope and nature of knowledge which would rule out all such investigations as meaningless. The question is not even whether there are e.g. any actual bodies which are 'perfectly rigid', any samples of distilled water which are actually free from all 'impurities', but whether such notions as 'a perfectly rigid body', 'pure distilled water', 'gold which contains no alloy', and the like really mean anything.

51 b 8. πῦρ αὐτὸ ἐφ' ἑαυτοῦ. The formula appears not to be a Socratic or Platonic invention, but to have been borrowed by the Socratic circle from fifth-century science. It means 'fire which is just fire', 'fire with no admixture of anything else', exactly as we speak of 'pure water', 'pure atmospheric air', 'pure gold'. Cf. Hippocrates Περὶ ἀρχαίης ἰητρικῆς 15 (Kühlewein, i. 17) *οὐ γάρ ἐστιν αὐτοῖς, οἶμαι, ἐξηυρημένον αὐτό τι ἐφ' ἑαυτοῦ θερμὸν ἢ ψυχρὸν ἢ ξηρὸν ἢ ὑγρὸν μηδένι ἄλλῳ εἴδει κοινωνέον*, 'I fancy they have never discovered anything which is just hot or just cold, just dry or just moist, and has no admixture of anything else in it'. The more usual Platonic formula *αὐτὸ καθ' αὑτό*, which occurs just below, is a variant on this with the same meaning.

ib. **περὶ ὧν ἀεὶ λέγομεν**, 'about which *we* are perpetually saying'. So in the *Phaedo* the technical terminology of the doctrine of Forms is ascribed by Socrates to a group of whom he speaks as 'we' in connexion with this very expression *αὐτὸ καθ' αὑτό* and its equivalents, 75 d 1 *περὶ ἁπάντων οἷς ἐπισφραγιζόμεθα τὸ "αὐτὸ ὃ ἔστι" καὶ ἐν ταῖς ἐρωτήσεσιν ἐρωτῶντες καὶ ἐν ταῖς ἀποκρίσεσιν ἀποκρινόμενοι*. So *Rep.* x. 596 a 6 Socrates says to Glaucon *εἶδος γάρ πού τι ἓν ἕκαστον εἰώθαμεν τίθεσθαι περὶ ἕκαστα τὰ πολλά, οἷς ταὐτὸν ὄνομα ἐπιφέρομεν* and 597 a 2 *οὐ τὸ εἶδος ποιεῖ, ὃ δή φαμεν εἶναι ὃ ἔστι κλίνη, ἀλλ' κλίνην τινά;* We might have supposed that the 'we' in these places meant simply the Socratic circle, but we see that it includes Timaeus of Locri (the only person except Socrates who ever speaks of the *εἴδη* at all). So it is clear that Plato meant the language about *αὐτὰ καθ' αὑτὰ εἴδη* to be regarded as Pythagorean.

51 c 3. τοιαύτην ἔχοντα ἀλήθειαν. *ἀλήθεια*, as most commonly in Plato, unless there is something in the immediate context to suggest 'truthfulness', has a more 'objective' signification than our 'truth' and would better be rendered 'reality'. So in *Rep.* vi. 508 e 3 when the *ἰδέα τἀγαθοῦ* is called *αἰτία ἐπιστήμης καὶ ἀληθείας*, *ἀλήθεια* means the counterpart in the 'objective world' of *ἐπιστήμη* in the mind, that which is the object of the knowledge of the *ἐπιστήμων*, 'reality', as may be seen from the preceding contrast (508 d 5) of *ἀληθειά τε καὶ τὸ ὄν*, 'real being', with *τὸ γιγνόμενόν τε καὶ ἀπολλύμενον*, 'mutability'. *τοιαύτην ἀλήθειαν* is explicitly taken by St. in his note, and implicitly by Martin and A.-H. in their renderings, as = 'the sort of *ἀλήθεια* we are in the habit of ascribing to the *εἴδη* of which we speak'. But the meaning surely is 'such *ἀλήθεια* as sense-percepts not corrected by reference to a standard of scientific truth have', and accordingly we should punctuate *μόνα ἔστιν, τοιαύτην ἔχοντα ἀλήθειαν*, rendering 'are all that exists, and have a corre-

sponding reality (and no more).' The words *seem* to convey an allusion to the title ἀλήθεια, by which, as we see from e.g. *Theaetetus* 161 c 4, the book of Protagoras was known to Socrates and his contemporaries. Note the reiterated φαμέν of c 4. The word εἶδος as well as the phrase αὐτὸ ἐφ' ἑαυτοῦ or αὐτὸ καθ' αὑτό is thus asserted to be Pythagorean. It is clear from more than one passage in the *Commentary* of Proclus on the *Parmenides* that Proclus still recognized the Pythagoreans as historically the originators of the doctrine of the Forms. Thus in commenting on *Parm.* 130 b 2, where Parmenides asks Socrates whether he had thought *for himself* of the doctrine that sensible things 'participate' in Forms (αὐτὸς σὺ διῄρησαι ὡς λέγεις), Proclus observes that the question is natural, since Socrates might have got the theory from others (*Comment. in Parmenid.* St., p. 609, Cousin v. 4 καὶ γὰρ εἰκὸς ἦν εἰς αὐτὸν ἥκειν λόγον, ὡς οἱ ἀμφὶ Παρμενίδην τοιαύτην τινὰ δόξαν ἔχουσι, καὶ τῇ δόξῃ πειθόμενον οὕτω λέγειν ἀλλ' οὐχὶ κατὰ οἰκείαν ἐπιβολήν). In an earlier passage of the same work (St. 562, Cousin iv. 149) he says more explicitly that the 'Pythagoreans had the doctrine of the Forms', and that it is they who are meant by the phrase τοὺς τῶν εἰδῶν φίλους at *Sophistes* 248 a 4 (ἦν μὲν γὰρ καὶ παρὰ τοῖς Πυθαγορείοις ἡ περὶ τῶν εἰδῶν θεωρία, καὶ δηλοῖ καὶ αὐτὸς ἐν Σοφιστῇ τῶν εἰδῶν φίλους προσαγορεύων τοὺς ἐν Ἰταλίᾳ σοφούς). As it is not the custom of Proclus to give mere conjectures of himself or others about the historical allusions in Plato without marking them as conjectural, Bt. is clearly justified (*Greek Philosophy, Thales to Plato* p. 91)[1] in the inference that this was the received Academic tradition. Aristotle's statements about Plato in *Met.* A. 6 imply the same thing. Aristotle is careful to tell us what he regarded as the two ἴδια Πλάτωνος, the distinctive features of Platonism. By distinctive features he means those which distinguish Plato from the Pythagoreans, the persons with whom Aristotle says he 'agreed' except for three specified differences (*Met.* A. 987 a 29 ἡ Πλάτωνος ἐπεγένετο πραγματεία, τὰ μὲν πολλὰ τούτοις ἀκολουθοῦσα, τὰ δὲ καὶ ἴδια παρὰ τὴν τῶν Ἰταλικῶν ἔχουσα φιλοσοφίαν). It is notable that Ar. does not regard the doctrine of the reality of the Forms nor even the doctrine that 'sensibles' participate in them as the ἴδια to Plato. He expressly says that the difference from the Pythagoreans about μέθεξις was merely verbal, and implies that, as far as the postulation of a realm of νοητὰ εἴδη is concerned, there was no difference at all.

51 c 5. οὐδὲν ἄρ' ἦν πλὴν λόγος, 'turns out to have been (was, after all, all the time) nothing but talk', i.e. nothing but empty words. The imperfect is used in such phrases of what one 'finds to have been the case' when one's eyes are opened to an error, because one discovers that the case really *was so* all the time one had supposed it to be otherwise; ἄρα is regularly combined with the verb because the discovery that one has been deluded is an *inference* from some consideration which 'opens one's eyes'. So we say, in similar cases, '*then* your professions were mere words after all'. For an excellent collection of examples of the

[1] Cf. also Olympiodorus *in Phaedon.* 65 d (ed. Norvin, p. 31) ὁ Σιμμίας ἑτοίμως συγκατατίθεται τῷ περὶ τῶν ἰδεῶν λόγῳ ὡς συνήθης Πυθαγορείοις τὰς ἰδέας πρεσβεύουσι· διὸ καὶ μεθ' ὅρκου τοῦτο προήγαγεν.

usage see Madvig *Greek Syntax* (E. Tr.), Appendix § 257 c (p. 225). For the contrast of λόγος, 'mere talk', 'an empty name', with ὄντα, cf. the lines which Brutus was reported to have quoted in his last moments ὦ τλῆμον ἀρετή, λόγος ἄρ' ἦσθ· ἐγὼ δέ σε | ὡς οὖσαν ἤσκουν.

51 c 5–d 3. οὔτε οὖν δὴ . . . ψῆφον. Timaeus does not offer a complete and final examination of the fundamental issue of metaphysics. A full justification of the doctrine of Forms would have to be of a length unsuitable for insertion in a cosmological discourse which itself is long enough already. But he feels that he must not meet opponents of the doctrine by a bare assertion. He proposes therefore very briefly (διὰ βραχέων) to indicate the general lines on which the case for the Forms should be argued, but not to work out the argument in detail. He gives his own personal conviction (ὧδε οὖν τήν γ' ἐμὴν αὐτὸς τίθεμαι ψῆφον) and indicates briefly the grounds on which he rests it. There is no attempt here or anywhere else in Plato to offer a formal demonstration of the doctrine; it is always represented as a postulate (ὑπόθεσις) which 'we' are agreed to admit. As 'we' are agreed, the rules of dialectic do not require the production of proofs any more than the rules of a modern law-court require the establishment by testimony of points which are not contested. It is only what the other party calls in question that you are required to 'prove'. The method adopted by Timaeus to 'determine' the issue sufficiently for his present purpose is simply to show that its decision depends on another issue which it is easier to 'determine', viz. whether there is or is not any difference between νοῦς, scientific grasp of truth, and ἀληθὴς δόξα, a belief which happens to be true. Is the mental state of the man who knows the truths of science adequately described by saying that he asserts propositions which are, in point of fact, true?

51 d 3–7. εἰ μὲν νοῦς . . . βεβαιότατα. *If* there is nothing more to be said about the attitude of the man who has 'knowledge' to his object than that his beliefs are in fact true, there is no need to recognize the existence of anything beyond 'what we perceive through the body', i.e. a purely sensationalistic phenomenalism will be an adequate doctrine in metaphysics. Impossible as it is to be certain that the judgements I base on my personal uncorrected impression of the immediate 'look' of things are exactly true, no reason can be given why they should not happen to be so. E.g. I can't be sure that what appears to my senses an exactly round disk or a perfectly polished surface is really so; but, on the other hand, I can't be sure that it is not so. My belief on the matter may happen to be true, though I have no means of being sure that it is true. If this were all we could say about the claims of scientific knowledge—if we could only say that it is a complex of propositions which 'happen' to be true, science need not be supposed to be more than a 'personal impression' of a certain man, and we need not assume the reality of any 'objects' except that man's *sensa*. If we have scientific knowledge which amounts to more than this, if there are sciences which are concerned with universal and necessary connexions, the objects studied in these sciences must be something more than the personal impressions of any one, and so there must be Forms which we apprehend

not by sense but by thinking. Hence, if we can give reasons, satisfying to ourselves, for distinguishing genuine *science* from personal impressions, this will be a sufficient defence of our metaphysical assumption, at least for the purposes of a discourse which has a different main topic.

With the formal procedure of Timaeus here compare that of Socrates at *Meno* 86 e 1 ff., which Socrates there describes as ἐξ ὑποθέσεως σκοπεῖν, 'considering a question from the point of view of an initial postulate'. There the question was whether ἀρετή can be taught. Socrates declines to discuss the point directly, but offers to examine it ἐξ ὑποθέσεως. I. e. he will consider what solution will follow if you grant him a certain postulate, viz. that 'virtue is knowledge'. If ἀρετή is knowledge it can readily be shown that it is διδακτόν. Whether it will be διδακτόν if it is *not* knowledge, he does not undertake to say. He declines to affirm the proposition that ἀρετή is διδακτόν categorically; he affirms instead the *implication* 'ἀρετή is ἐπιστήμη' implies that 'ἀρετή is διδακτόν'. He illustrates this way of reducing one question to a different one, or of restricting the scope of an inquiry by introducing an initial condition from geometry in a way which indicates the origin of σκέψις ἐξ ὑποθέσεως in reflection on mathematical method. A geometer is supposed to be asked (*Meno* 86 e 6) whether it is possible to inscribe in a given circle a triangle of given area (εἰ οἷόν τε ἐς τόνδε τὸν κύκλον τόδε τὸ χωρίον τρίγωνον ἐνταθῆναι). The geometer declines to answer the question as it stands, but replies that if a special condition is assumed (we need not here discuss the precise character of the condition) the problem is soluble, but may not be so if this condition is not fulfilled. The technical name in the geometry which was eventually built up by the Academy and codified in the third century by Euclid for such a specified initial restriction upon which the solution of a problem turns was διορισμός. (Cf. Proclus *in Eucl.* ed. Friedlein 66. 22, where we are told that the Academic mathematician Leon did much work in the finding of διορισμοὶ πότε δυνατόν ἐστι τὸ ζητούμενον πρόβλημα καὶ πότε ἀδύνατον.) Timaeus is here laying down a διορισμός, 'the sensationalist account of reality is a possible solution of the problem of metaphysics if there is nothing in science beyond a collection of propositions which are *de facto* true; if science is more than this, sensationalism is an inadequate theory'. The use of the words ὅρος, ὁρισθείς, in d 1 alludes to the mathematical origin of the method. The procedure is strictly in accord with the account of ὑπόθεσις in the *Phaedo*. The ὑπόθεσις, 'there are νοητὰ εἴδη', is shown to follow from the more ultimate ὑπόθεσις, 'science is more than a collection of propositions which happen to be true'. T. assumes that any man of science will regard *this* ὑπόθεσις as ἱκανόν, 'satisfactory'.

51 d 3. νοῦς καὶ δόξα ἀληθής. What *is* the difference? What is there more in 'science' than there is in 'judgement which is true'? The answer is familiar from the *Meno* (97 e—98 a). In order that true judgements may be converted into ἐπιστῆμαι, 'sciences', they must be made 'fast' by 'binding them', αἰτίας λογισμῷ, 'by calculation of the reason *why*'. To have science it is not enough to assert propositions which are true. We have to discuss the 'universal and necessary' *connexions* between them. E. g. it is not science to know merely that *A* is true,

B is true, and *C* is true; you are on the road to science when you can see that '"*A* is true and *B* is true" *implies* that *C* is true' also'. Since mere personal sense-impressions never give us 'connexion' of this kind ('experience concludeth nothing universally'), science cannot be founded merely on sensations. A world which can be scientifically known must contain 'universals' which form a logically connected system. We must not read into the word νοῦς here the special sense it has in Aristotle's theory of knowledge, direct apprehension of the universal unproved first principles (ἀρχαί) of science as opposed to ἐπιστήμη, the 'mediate' knowledge of the consequences which are deduced from them. This distinction is not made by Plato. With him νοῦς and ἐπιστήμη are both names for the same thing, rational science. He has no separate name for the apprehension of first principles.

51 d 6. ὃς τισι φαίνεται. The view that 'science' = ἀληθὴς δόξα is discussed and dismissed in the *Theaetetus* (187 b—201 c), where it is the second of three proposed definitions of ἐπιστήμη, none of which proves satisfactory. Socrates and Theaetetus examine it after the break-down of the first attempt to identify ἐπιστήμη outright with αἴσθησις. The considerations produced by Timaeus in 51 e to show that ἐπιστήμη is not simply ἀληθὴς δόξα are a summary statement of results which are worked out more fully in the *Theaetetus*. They are not meant for a demonstration, and are not the main grounds on which the identification is rejected in that dialogue. They are simply appeals to εἰκότα, 'the plausibilities of the case'. Demonstration is not needed here, since none of the audience are likely to dispute the point. For readers familiar with the *Theaetetus* the passage amounts to a reminder that the subject has already been fully discussed on its own merits in that work, and presumably Plato intended it to be taken so. It would hardly have been historically justifiable to put into the mouth of a Pythagorean contemporary of Empedocles so fully developed a logical and epistemological doctrine as that expounded in the *Theaetetus*. The fatal objection to the definition is there found to be that in defining ἐπιστήμη as ἀληθὴς δόξα we are presupposing that we already know what is the difference between a true and a false δόξα. Thus it is assumed that we already know what error is while we are still confessedly unable to say what knowledge is. The real reason of the failure of the attempts to define ἐπιστήμη is that Socrates and Theaetetus are looking for a *psychological* criterion of true judgements. They are trying to discover some psychological peculiarity which is common to true judgements and only to true judgements, and no such peculiarity is to be found. There is really *no* character which is common to and peculiar to true judgements beyond the character of being true. This is (*a*) not a *psychological* characteristic, and (*b*) cannot enable us to define truth in terms of something other than itself. In the end we have to admit that 'true', 'like good', is a term too simple to be capable of being defined at all. (Cf. the remarks on this point in W E. Johnson *Logic* Pt. I, p. 8.) The radical distinction between ἐπιστήμη and δόξα of any kind is also insisted on strongly in *Rep.* v. 476 ff., but neither here nor in the *Theaetetus* nor in the *Republic* are we told who in particular held the views which are being attacked. Antisthenes has been

fixed on, but on wholly insufficient grounds. In an age of scepticism about science, like the middle of the fifth century, the theory is natural enough.

51 e 1–6. Timaeus specifies three obvious ways in which νοῦς and ἀληθὴς δόξα differ. (1) We get them in different ways. The first is acquired by learning or being taught (διδαχή), i.e. depends on intellectual conviction. The second may be induced by mere 'persuasion' or 'eloquence' (πειθώ), i.e. by appeals to sentiment, authority, prejudice, and the like, which may produce an effect, may *cause* the person to whom they are addressed to accept a belief, but are not a reason or ground for it. A belief which is, in fact, true may thus be produced without the production of any real ground, but we cannot call a true belief produced in this way genuine 'knowledge'. The *Theaetetus* (201 c 4–7) illustrates the point from the way in which δικασταί may be led to a verdict by skilful advocacy. In the law-court the advocate who is trying to get the jury to find a certain verdict persuades them that e.g. the accused has done a certain act at a certain place and time and with certain circumstances. The jury have not been witnesses of the act and cannot be said to *know* that it was done; the advocate himself does not *know* this. Yet by a suitable appeal to their feelings and prejudices, the advocate may make them believe that the man has done the act, and he may in fact have done it. In that case the δικασταί have a true belief but they have not *knowledge*. The same considerations apply wherever a man is persuaded, as so often happens in political life, into a true opinion by a thoroughly fallacious argument. This is, in fact, the reason for the contemptuous treatment of 'rhetoric' in the *Gorgias*. The orator is a man who by skilfully adapting the tone of his pleadings to his audience inspires them with beliefs about matters of which neither he nor they have any knowledge at all (like a modern 'political party leader' advocating a short cut to the Millennium). The point here is the same as that of the *Meno*. It is the 'fixing' of the true belief by understanding of the 'reason why' which advocacy does not supply.

(2) νοῦς is always attended by ἀληθὴς λόγος, 'true discourse'; mere true opinion is not. If you really know a proposition, you can justify it when called on to do so. You can show me 'good reason' for your conviction on the point. But you may hold an opinion, and it may be a perfectly true one, and yet if I ask you to justify it, you may be quite unable to do so. You may have nothing better to say than that you feel sure your opinion is true. Now, if you have nothing more to say on behalf of a proposition than that you feel very sure it is true, it is absurd to see no difference between your own case and that of a man who could 'give his reasons' for holding the same view. In the *Theaetetus* the definition of knowledge as 'true opinion with ability to give an account of it' is the third of the three examined. Theaetetus says there that he had once heard some one say τὴν μετὰ λόγου ἀληθῆ δόξαν ἐπιστήμην εἶναι (201 c 9). He does not say from whom he had heard this, though it is hinted that there is some connexion between this view and that which Socrates goes on to say he himself 'seems to have heard in a dream' that complexes can be defined—you can give a λόγος of them—but the

ABC of which they are composed can only be taken in by simple apprehension. We saw that this second view was in all probability Pythagorean, and thus it seems natural to suppose that the definition Theaetetus had heard is Pythagorean too. This seems to me to become almost certain when we consider that the words quoted by Theaetetus *τὴν μὲν μετὰ λόγου ἀληθῆ δόξαν ἐπιστήμην εἶναι, τὴν δὲ ἄλογον ἐκτὸς ἐπιστήμης· καὶ ὧν μὲν μή ἐστι λόγος, οὐκ ἐπιστητὰ εἶναι . . . ἃ δ' ἔχει ἐπιστητά* are nearly identical with those used by Timaeus. It is not disputed in the *Theaetetus* that this may be a correct statement about knowledge; Socrates points out that the expression *μετὰ λόγου* is ambiguous, and that the most satisfactory of the possible interpretations would be that knowledge is true opinion about a thing accompanied by *the* λόγος which points out the *διαφορότης* of the thing in question, that which distinguishes it from everything else. He then observes that as a definition, the proposition has the defect that if all that is meant is that one must have 'right opinion' about the *διαφορότης*, we still have only 'right opinion', not knowledge; but if what is meant is that knowledge is 'right opinion about a thing with *knowledge* about its *διαφορότης*', the definition is circular. This would be no reason to deny that the statement in question may be a true statement about *ἐπιστήμη*, though it is not a definition of it. Timaeus gives it merely as a true statement about *νοῦς*, not as a definition. He does not attempt to *define* *νοῦς* at all.

(3) You cannot change a man's conviction about what he really knows by *πειθώ*, 'advocacy', clever appeals to his feelings and prejudices; you can change a 'true belief' in this way. E.g. suppose I believe that Free Trade is the best commercial policy for the United Kingdom, and that this is a true opinion. If I am thrown among persons who are strongly hostile to Free Trade and are always giving vent to their hostility, and if I also can give no satisfactory reasons for my belief in Free Trade (as is usually the case with the opinions of most persons on such questions), the effect of finding my opinion treated with dislike and contempt as one which 'the right people' do not accept may be to lead me to 'change my views'. But no amount of 'social sentiment' will convince a man that a proposition of which he knows and retains the proof is not proved.

Note that the very points which are mentioned in the *Theaetetus* as making a difference between mere *ὀρθὴ δόξα* and *ἐπιστήμη* reappear here as making the difference between *νοῦς* and *ἀληθὴς δόξα*. This proves that Plato, as we said, is making no distinction of the Aristotelian kind between *νοῦς* and *ἐπιστήμη*.

51 e 6—52 d 1. τούτων δὲ οὕτως ἐχόντων . . . γενήσεσθον. The result of our consideration is then that our *ὑπόθεσις* that we cannot give an account of the sensible world in terms of less than three factors, *παραδείγματα*, *ὑποδοχή*, *μιμήματα*, stands, just as Dr. Whitehead's account of the same thing requires the three factors which he calls 'objects', 'space-time', 'events'. Timaeus once more very briefly dwells on the distinctive characteristics of each of the three, and the sources from which we get our knowledge of each of them. The pattern or *εἶδος* is self-same, exempt from all 'passage', imperceptible to the senses (*ἀναίσθητον*), and is apprehended by thinking (*νόησις*). The *μίμημα* which is called by the same name as

its pattern, is implicated in 'passage', is, in fact, that which 'passes', is known through the senses. The ὑποδοχή, which now at last receives the actual name χώρα, 'room', 'space', is that in which passage is 'situated'; like the εἶδος, it does not itself 'pass', and like it is apprehended not by sense but by a mysterious 'bastard' kind of thought. It is impossible to simplify this triad by eliminating any member of it. The point of special importance is that space, though not a παράδειγμα, is like παραδείγματα in not being 'in the making', and like them also in not being apprehended through sense, though the thought which does apprehend it is of a peculiar kind. Its peculiar status is that though it does not 'pass', it does not, like the other term of the triad which is exempt from 'passage', function as the 'type' of sensible events, but as that which provides them with their 'situations' (ἕδραν).

52 a 3. οὔτε αὐτὸ εἰς ἄλλο ποι ἰόν. This must not be taken as indicating any difference between the Forms of the *Timaeus* and those of the *Phaedo*. In the *Phaedo* we hear of the παρουσία or 'presence' of Forms to αἰσθητά and of the 'withdrawing' or 'retreating' of a Form from an αἰσθητόν. But these are merely metaphorical expressions, like the 'ingredience' of objects into events of which Dr. Whitehead speaks. They are no more supposed to describe a change of behaviour in the Form than Scriptural expressions in which God is spoken of as growing angry or changing His mind are held by orthodox theologians to ascribe change to God. Socrates himself speaks in a way which indicates dissatisfaction with such metaphors at *Phaed.* 100 d 5 ἡ ἐκείνου τοῦ καλοῦ εἴτε παρουσία εἴτε κοινωνία εἴτε ὅπῃ δὴ καὶ ὅπως †προσγενομένη· οὐ γὰρ ἔτι τοῦτο διισχυρίζομαι, ἀλλ' ὅτι τῷ καλῷ πάντα τὰ καλὰ [γίγνεται] καλά.

52 a 5. ὁμώνυμον ὁμοιόν τε ἐκείνῳ. ὁμώνυμος, as regularly, is used by Plato, in precisely the same sense as Aristotle's συνώνυμος; it means that which has not only the same name but the same λόγος τῆς οὐσίας as something else. The point always dwelt on specially by Plato is not that the Forms have the same name as the γιγνόμενα which 'participate' in them, but that the γιγνόμενα take the name of the Form. Cf. *supra*, 41 c 6 ἀθανάτοις ὁμώνυμον, *Parm.* 133 d 2 τὰ δὲ παρ' ἡμῖν ταῦτα ὁμώνυμα ὄντα ἐκείνοις, *Sophist.* 234 b 7 μιμήματα καὶ ὁμώνυμα τῶν ὄντων ἀπεργαζόμενος τῇ γραφικῇ τέχνῃ. So in Aristot. *Met.* A. 987 b 10 sensible things are called τὰ πολλὰ τῶν συνωνύμων τοῖς εἴδεσιν. This is because the name has a determinate significance; it therefore only belongs in a derivative and secondary way to a μίμημα or αἰσθητόν, which is only an imperfect reproduction of the determinate οὐσία named.

52 a 6–7. γιγνόμενον . . . ἀπολλύμενον. The αἰσθητόν is not only all the time 'in the making'; it is equally true to say that it is all the time in the 'unmaking'. This latter point is specially denied of χώρα at a 8 by the words φθορὰν οὐ προσδεχόμενον.

52 a 7. δόξῃ μετ' αἰσθήσεως περιληπτόν. This is the exact Platonic expression for the mode in which we apprehend the 'sensible particular'. It is a looser way of speaking to say that the sensible in apprehended by αἴσθησις, since we have to record any fact of observation in a *judgement*, and judgement is not sensation, though it may be based on sensation. Every judgement, even if it be a 'perceptual judgement' of the very

crudest kind, implies in it some of those universal characters or categories of which we are told in the *Theaetetus* that the ψυχή apprehends them 'by herself without the intervention of organs' (*αὐτὴ δι' αὑτῆς ἡ ψυχὴ τὰ κοινὰ φαίνεται περὶ πάντων ἐπισκοπεῖν, Tht.* 185 e 1). These *κοινά* include 'being', 'not-being', as well as likeness, unlikeness, identity, and difference. The simplest significant statement therefore implies some of them, and hence no significant communication is an expression of *αἴσθησις* pure and simple. It would not be exact, again, to say that we apprehend the sensible by δόξα, since we may have δόξαι about much that is not sensible, e. g. I may have δόξαι about God or about the multiplication-table. The accurate expression is that perception is 'judgement grounded on sensation'. (It is clear that this view is so far correct that perception is not identical with having sensations. Whether it is true that perception itself *is* a kind of judgement is a more difficult question. It might be urged that perception is *sui generis* and that the object apprehended when I see a red rose, viz. the red rose, is different from the redness of the rose or the rose's-being-red, which is the object apprehended when I judge that 'the rose is red'. But we need not discuss this subtlety here.)

52 a 8. τὸ τῆς χώρας ἀεί. *ἀεί* = *ἑκάστοτε*, 'in every case', not 'always' or 'all the time'. The name χώρα is not given to the ὑποδοχή until Timaeus has first explained what he takes to be the character and function of the ὑποδοχή. If it had first been called χώρα and then described we might have imported something illegitimate into our notion of it on the strength of associations which had already grown up in our minds in connexion with the name. As it is χώρα is *defined* as the name for that which has the character and function already specified; we are to assign to 'space' the character and function already described and no other.

52 b 2. μετ' ἀναισθησίας. This has no bearing on the question raised in modern psychology whether 'voluminousness' or 'extensity' is not a character either of all our sensations (as James maintains), or at any rate of some classes of them, e. g. those of sight and touch. All that Timaeus means is that you never 'sense' unfilled volume or mere volume which has no further 'quality', and the 'nativistic' theories of space-perception in modern psychology do not dispute this.

52 b 2. λογισμῷ τινι νόθῳ, μόγις πιστόν. Why *νόθῳ*? Presumably for the same reason that it was said before (51 b 1) that there is a puzzle about the way in which the ὑποδοχή 'partakes of the intelligible'. It is that 'which receives all figures but has itself none', as we have been sufficiently told. If we want to grasp the notion we have to think away all that is characteristic of every determinate figure. Space thus, at first at any rate, seems to be something about which we can make none but negative statements, such as that it is not square, it is not round, and the like. You would expect that what you cannot ascribe a determinate predicate to is just nothing at all; 'genuine' (*γνησία*, 'true-born') *νόησις*, you would think, is the apprehension of what its object positively *is*, not of what it is *not*. (Cf. Themistius *in Aristot. de Anima* iii. 6, ed. Spengel, ii. 205 *καὶ τὸ Πλατωνικὸν τοῦτο ἂν εἴη περὶ τῆς ὕλης, ὅτι νόθῳ λογισμῷ λητπτή· νόθος γὰρ ἀκριβῶς ἐνέργεια καὶ τοῦ νοῦ καὶ τῆς αἰσθήσεως ἡ μὴ κατ' ἐπέρεισιν εἴδους ἀλλὰ κατ' ἀναχώρησιν γιγνομένη.*) The 'puzzle' is pre-

cisely that in spite of the difficulty of asserting any *predicate* affirmatively about space, space is not really simple nothingness but has a positive character. It is, in fact, one 'continuum' among the various 'continua' known to us, and has a character of its own by which it is distinguished, e. g. from the colour-continuum or the musical scale. But to discover this special character, the spatial *quale* as it has well been called, you have to study not 'the properties of space' but the properties of the various figures which can be constructed in space. The whole body of Euclid's postulates, express or implicit, form the *quale* of the continuum which we call a Euclidean space. You can't directly point out an attribute or a complex of attributes and say 'that is the differentia of space', as you might say that mortality *plus* rationality is the differentia of man. Euclid's complete set of postulates are the *quale* of 'Euclidean space', but 'space' is never mentioned in any of them. They are statements about 'points', 'straight lines', 'angles', and so on, not statements about 'space'. Thus space is not as such itself *figured*, but yet you can only discover what space is by studying the relations between figures. It has not 'attributes', and yet it is not nothing but is just *this* definite continuum. (The same thing might be said of the colour-continuum, or of any other. The colour-continuum is not a colour and has no colour; what its *quale* is has again to be discovered by study of the colours which are its elements. But the spatial continuum has a peculiarity which gives it an importance that the colour- or sound-continuum has not. *All* the events which make up the passage of nature fill some volume; not all of them include colour or sound.) The language becomes less difficult to follow if we remember the point of Parmenides' polemic against the 'space' in which Pythagoreans had held that 'figures' are formed. Parmenides had argued that all his precursors had gone wrong in consequence of one and the same error. They had assumed that what is not, τὸ μὴ ἐόν, is something which has a character of its own and plays an important part in the life of the world. But what is not, he says, cannot so much as be thought or spoken of. Whatever can even be spoken of must be spoken of as a something. It has a definite character proper to itself. If it had not, then in trying to speak of it you would not really be speaking of *it*, but of something different. Now Parmenides made it quite clear that by 'what is' he understood body, and by 'what is not' empty space. His reason for declaring all the cosmologies false is that they all assume that there is space where there is not body. Professor Eddington tells us that regions where there is 'matter' are the exception in the universe, and that what is most interesting to the physicist is the study of the regions which are 'empty'. I suppose we too find something paradoxical in the statement; we ought therefore to understand why Parmenides was scandalized. Timaeus is perhaps intentionally countering Parmenides' argument that you cannot think of such a thing. He says you *can* think of it but only in a 'bastard' way. This is a palliation of the mistake of Parmenides. If you arrive at the notion of space through negatives, it is excusable that P. should have supposed that there is no such notion. Plato himself had taught in the *Sophistes*, in a different connexion, that

Parmenides was wrong in saying without qualification that 'what is not' is blank nothing. But there too he had been very careful to make his mouthpiece, the unnamed Eleatic, express deep reverence for the genius of Parmenides and offer an apology for being forced to depart from his doctrine. (*Sophist.* 241 d 1 *τόδε τοίνυν ἔτι μᾶλλον παραιτοῦμαί σε.—τὸ ποῖον;—μή με οἷον πατραλοίαν ὑπολάβῃς γίγνεσθαί τινα.—τί δή;—τὸν τοῦ πατρὸς Παρμενίδου λόγον ἀναγκαῖον ἡμῖν ἀμυνομένοις ἔσται βασανίζειν.*)

If we were to look for traces of Democritus in the *Timaeus* at all, perhaps the phrase about *νόθος λογισμός* looks more like an echo of him than anything else in the dialogue. Democritus' way of asserting that sense-qualities are 'subjective' effects of the primary qualities of atoms was to distinguish two kinds of cognition, the 'true-born' (*γνησίη*) and the 'base-born' (*σκοτίη*, a poetical equivalent for the prose *νόθη*). The sense-qualities, colours, smells, tastes, &c., he said, belong to the 'base-born' cognition (Sextus Empiricus *adv. Math.* vii. 139, *Fr. d. Vors.*[3] ii. 60 = R. P. 204 *γνώμης δὲ δύο εἰσὶν ἰδέαι, ἡ μὲν γνησίη, ἡ δὲ σκοτίη· καὶ σκοτίης μὲν τάδε σύμπαντα, ὄψις, ἀκοή, ὀδμή, γεῦσις, ψαῦσις. ἡ δὲ γνησίη, ἀποκεκριμένη δὲ ταύτης.*) But though there is a certain similarity of language there is no particular resemblance of thought. What the *σκοτίη γνώμης ἰδέα* apprehends is colour, tone, scent, and the other 'sensibles'; the *νόθος λογισμός* of T. apprehends volume as such, and is a kind of *thinking*. Also Timaeus, who makes space of fundamental importance in his theory of nature, cannot intend to suggest by the epithet *νόθος* what Democritus meant to suggest by talking about sense-perception as *σκοτίη* (cf. the well-known words, *Fr. d. Vors.*[3] ii. 60 [Democr. ap. Sext. *adv. Math.* vii. 135 = R. P. 204] *νόμῳ γλυκύ, νόμῳ πικρόν, νόμῳ θερμόν, νόμῳ ψυχρόν, νόμῳ χροιή, ἐτεῇ δὲ ἄτομα καὶ κενόν*), that it is 'illegitimate' to ascribe objective reality to that which is apprehended by the *νόθος λογισμός*. If there is anything more than a coincidence between the phraseology of Timaeus and that of Democritus, it is even possible that the explanation may be due to a common Pythagorean origin, as we saw to be most likely in the case of the illustration from the *ABC*. But probably we are dealing with a mere coincidence. *μόγις πιστόν* only means that we find it hard to 'believe in' *χώρα* as a constituent of the world even when reflection, *λογισμός*, forces us to do so, exactly as many a nineteenth-century student must have found it hard to 'believe in' the so-called 'ether of space', even while he might not see how to dispense with it. There is no allusion to the mention of *πίστις* at *Rep.* vi. 511 e 1 as the proposed name for the kind of *δόξα* involved in the perception of actual bodies in distinction from *εἰκασία*, the *δόξα* of the being who has not yet learned to discriminate firmly between shadows and solid substances. Our apprehension of *χώρα* according to the statements we have just been hearing is not *δόξα* at all.

52 b 3–d 1. As everything which 'passes' or 'occurs' occupies some region or volume, we tend to make the illegitimate inference that everything which *is* is *somewhere*, and so become blind to the eternal realities, which do not 'occupy space' at all. We ought to recognize that to be 'in' a region, to be 'in' something other than itself is a *proprium* of what 'becomes'; that which is never 'in the making' cannot be 'in' anything

but itself. The pertinence of this remark that 'extension' belongs only to 'what is in the making', *μιμήματα*, becomes obvious when we recall the character of the metaphors used, e. g. in the *Phaedo* to portray the relation of a Form to a sensible thing. The Form is said 'to be present to' the thing (*παρεῖναι*), 'to occupy it' (*κατέχειν*), or to 'retreat' from it (*ὑπεκχωρεῖν*), all spatial metaphors, and the last two taken from the military 'occupation' of or withdrawal from a position. T. is of opinion that it is necessary to insist that such language must not be taken to be more than a metaphor.

52 b 3. *πρὸς ὃ δὴ καὶ ὀνειροπολοῦμεν βλέποντες*, 'with relation to it (space), moreover, we dream with our eyes open', 'dream while we are broad awake'. *βλέπειν* is here used in the absolute sense, 'to have the power of sight', as opposed to *τυφλὸς εἶναι* or to *μύειν*, 'to have one's eyes shut'. Cf. Aeschylus *P. V.* 447 *βλέποντες ἔβλεπον μάτην*, Soph. *O. T.* 747 *δεινῶς ἀθυμῶ μὴ βλέπων ὁ μάντις ᾖ*.[1] It would be just possible to construe the word with *πρὸς ὅ*, and render 'it is with our view fixed on it that we dream', but it seems hard to separate *βλέποντες* from *ὀνειροπολοῦμεν* in this fashion, though Chalcidius and St. appear to have done so. M. goes badly astray. He understands the sense to be that it is the *ὑποδοχή* itself of which we have no clear vision, 'nous ne faisons que l'entrevoir comme dans un songe'. This is hardly admissible as a version of the words, since it ignores the presence of the *πρός*. In point of sense, it is clearly wrong. The complaint is not that men do not understand what extension is, but that they suppose the Forms to be extended and to be 'in space'; this is the illusion which T. speaks of as a 'waking dream'. A.-H.'s translation is a little ambiguous, but his note shows that he interprets rightly. He, however, construes *βλέποντες* with *πρὸς ὅ*. The position of *βλέποντες* would be a very harsh hyperbaton indeed if the construction indicated by his and St.'s renderings were adopted.

52 b 4. *ἔν τινι τόπῳ*. Aristotle does actually raise the question whether Plato ought not, on his own principles, to have said that the Forms are in 'space', if space is the 'receptacle' described in the *Timaeus*, *Physic.* Δ. 209 b 33 *Πλάτωνι μέντοι λεκτέον . . . διὰ τί οὐκ ἐν τόπῳ τὰ εἴδη καὶ οἱ ἀριθμοί, εἴπερ τὸ μεθεκτικὸν ὁ τόπος, εἴτε τοῦ μεγάλου καὶ τοῦ μικροῦ ὄντος τοῦ μεθεκτικοῦ, εἴτε τῆς ὕλης, ὥσπερ ἐν τῷ Τιμαίῳ γέγραφεν.* (Ar. had said just before at 209 b 11 that Plato had identified *ὕλη*, the 'material' constituent in things, with *χώρα* in the *Timaeus*, but that in his 'unwritten teachings' he used different language, though, as Aristotle seems to suggest, to the same effect: *διὸ καὶ Πλάτων τὴν ὕλην καὶ τὴν χώραν ταὐτό φησιν εἶναι ἐν τῷ Τιμαίῳ· τὸ γὰρ μεταληπτικὸν καὶ τὴν χώραν ἓν καὶ ταὐτόν. ἄλλον δὲ τρόπον ἐκεῖ τε λέγων τὸ μεταληπτικὸν καὶ ἐν τοῖς λεγομένοις ἀγράφοις δόγμασιν, ὅμως τὸν τόπον καὶ τὴν χώραν τὸ αὐτὸ ἀπεφήνατο.* We may infer then that it was the doctrine of the *ἄγραφα δόγματα* that the 'receptacle' is the (or a) 'Great-and-Small'.) Aristotle's criticism is even more than usually unsympathetic in this case. The suggestion is that Plato had spoken of something which 'receives' the Forms, and that

[1] And Dante *Paradiso* xxix. 82 'Sì che laggiù non dormendo si sogna | Credendo e non credendo dicer vero'.

the context showed that this something is space. Ergo, he contradicts himself in denying that the Forms are 'in' space. The obvious rejoinder would be that it is never said that χώρα is an ὑποδοχή of the παραδείγματα at all, only that it 'receives' (δέχεται) the μιμήματα. From Aristotle's own way of referring to the statement of the ἄγραφα δόγματα we may fairly infer that there too the 'Great-and-Small' was said to be 'that which receives' copies or off-prints of the Numbers, not that which receives the Numbers themselves. It is also, as Zeller said, not true that Timaeus teaches that matter is space. Zeller said that what T. teaches rather is that space is matter. It would be still nearer the truth to say that T. says neither of these things. Matter really plays no part in his cosmology at all. The 'permanent implied in change' is not thought of by him as a 'stuff' or a 'substrate'. In being the permanent implied in change, it discharges the same function which ὕλη or 'matter' does in the *Physics* of Aristotle, but there the resemblance of the two notions stops. There is no '*substrate* of change' in the scheme of Timaeus. Aristotle is himself so imbued with the view that the permanent implied in change can only be thought of as 'stuff' or 'substrate', that he was probably unconscious that he was falsifying the theory of the *Timaeus* by forcing his own technical terminology into it.

52 b 6–c 1. ταῦτα δὴ πάντα . . . λέγειν. Since the ταῦτα and ἄλλα are the objects after διοριζομένῃ, the words cannot mean the erroneous fancies which have just been mentioned; rather they mean the distinctions which T. has been making between what 'is' and what 'passes' and all the further distinctions they carry with them. The influence of the 'dream' is what prevents us from 'waking from our slumber and making these distinctions and others connected with them'.

52 b 7. ἄυπνον. The word occurs in Plato only here, and ἄγρυπνος, which does occur elsewhere, is used by him only in its literal sense of 'wakeful'. The context in the present passage suggests that M. is right in taking ἄυπνον to mean 'not seen in sleep', as opposed to ἐνυπνία, 'dreams', the thought being that it is the Forms, which are not in space at all, that are the true 'waking world' or 'realities of waking life', as contrasted with the bodily world which seems so real to most men, but is, in the philosopher's judgement, a realm of εἰκόνες or 'shadows'. Hence the conjunction with ἀληθῶς ὑπάρχουσαν, 'no dream but a reality'. But there may also be an allusion to the unceasing life of the real world, which never 'slumbers nor sleeps'. Plotinus, as St. notes, alludes to the phrase more than once. Cf. *Enn.* iii. 6. 6 οἳ παραπλήσιον τοῖς ὀνειρώττουσι ποιοῦσι ταῦτα ἐνεργῇ (? ἐναργῇ) νομίζουσιν ἃ ὁρῶσιν ἐνύπνια ὄντα. καὶ γὰρ τὸ τῆς αἰσθήσεως ψυχῆς ἐστιν εὐδούσης· ὅσον γὰρ ἐν σώματι ψυχῆς, τοῦτο εὕδει. *Enn.* ii. 5. 3 εἰ δὴ καλῶς εἴρηται ἐκείνη ἡ φύσις ἄγρυπνος εἶναι καὶ ζωὴ καὶ ζωὴ ἀρίστη, αἱ κάλλισται ἂν εἶεν ἐκεῖ ἐνέργειαι. Plotinus there seems to assume as the meaning of ἄυπνος what I take to be only a remote suggestion.

52 c 2–4. ὡς εἰκόνι μὲν . . . ἐστιν. The phrase has been most fully explained by C. W. The point is that an εἰκών or likeness is always a likeness of something other than itself. (C. W. speaks as though it were true of every 'relative' term that it is the correlate of something other

than itself. This seems both bad logic and bad law. According to our own law a man may be at once his own murderer and his own victim. There is nothing to prevent a man in many cases from being his own nominator and nominee for a post. In the days of the old 'rotten boroughs' I suppose a man might even in an extreme case have been his own constituency.) But it is true of a 'likeness' or 'reflection' that it is never its own original. The meaning then is simply that a copy or likeness is not even a copy or likeness of itself but always of something else. But instead of saying 'is not a εἰκών of itself', Timaeus says is not αὐτὸ τοῦτο ἐφ' ᾧ γέγονεν of itself, not 'the very-thing-it-was-meant-for of itself'. That ἐφ' ᾧ τι γέγονε is 'that for which it was constructed', 'what it was meant to be'. Hence, as C. W. says, the phrase is an equivalent to the common Platonic αὐτὸ ὅπερ ἔστι, 'what the thing really is'. The ὅπερ ἔστι of an image, its οὐσία, is just to *be* an image or reflection. So the phrase means 'an image is not even the thing-which-it-really-is of itself', i.e. is not an image of itself but of something else. For the phraseology and the use of the genitive cf., with C. W., the language of the discussion about correlated terms in *Rep.* iv. 438 ff., e.g. 438 a 7 ὅσα γ' ἐστὶ τοιαῦτα οἷα εἶναί του, τὰ μὲν ποιὰ ἄττα ποιοῦ τινός ἐστιν, ὡς ἐμοὶ δοκεῖ, τὰ δ' αὐτὰ ἕκαστα αὐτοῦ ἑκάστου μόνον, 'of things which are such as to be *of* something, those which have a qualification are *of* something with a qualification, those which are just so-and-so are *of* a just so-and-so'. I.e. the imposition of a special qualification or restriction on one of a pair of correlated terms involves a corresponding restriction on the other. Grammatically this use of the genitive to represent relation is an extension by analogy from the use of the genitive with comparatives.

52 c 3–5. διὰ ταῦτα . . . ἀντεχομένην. The connexion of thought is that since from its very nature an image is an image *of* something else, it is very proper that it should also appear *in* something else. I.e. the image seems or pretends to be that of which it really is only an image. Since then it *seems* to be something which it *is* not, it is appropriate that it should appear to be also *in* something in which it is not. The key to the connexion is the relation of the 'face in the glass' to the glass. It seems to be what it is not, a face directly seen in the normal way, and it is only fitting therefore that it also seems to be somewhere, i.e. behind the mirror, where in fact there is not a face. Timaeus means that space is to the παραδείγματα what the surface of a mirror is to the objects the mirror reflects. οὐσίας ἀμωσγέπως ἀντεχομένην, a legal metaphor, 'setting up a claim to being, as best it can', means that the events of nature, like the reflections from the mirror, are not really ὄντα but γιγνόμενα. They 'would be ὄντα if they could', just as we are told in the *Phaedo* that the 'equal' things we perceive through sense 'try' to be really equal but never quite succeed (75 a 2 ὀρέγεται μὲν πάντα ταῦτα εἶναι οἷον τὸ ἴσον, ἔχει δὲ ἐνδεεστέρως, b 7 προθυμεῖται μὲν πάντα τοιαῦτ' εἶναι οἷον ἐκεῖνο, ἔστιν δὲ αὐτοῦ φαυλότερα). That is, just because γιγνόμενα are always 'in the making', they tend to be something to which they never do more than approximate. (The *conatus* which is characteristic of a γιγνόμενον is not, as Spinoza says, a *conatus in suo esse perseverandi* but a conatus

towards 'betterment'.) The nearest approach these *αἰσθητά* make to having an *οὐσία* is to reflect an *οὐσία* which they never quite make their own. If one tries to follow up the thought which is thrown out in this rather fanciful way, it would seem to amount to the suggestion that *because the γιγνόμενον is 'in time' it is also 'in space'; occupation of space is, in some way, a consequence of occupation of time.* The whole clause, then, means 'since an image is not even an image of itself, but an incessantly shifting reflection of something else, it is meet that, in its endeavour to lay such claim to Being as it can, it should arise *in* something other than itself, or else be nothing at all'.

52 c 6. βοηθὸς ὁ δι' ἀκριβείας λόγος. The *βοηθός* keeps up the legal metaphor of *ἀντεχομένην*. The *γιγνόμενον* and the *ὄντως ὄν* are rival claimants of *οὐσία*, and 'exactly true' 'scientific' discourse advocates the claim of the *ὄντως ὄν*. What the *λόγος* or 'plea' which supports the claim of the *ὄντως ὄν* is is explained by the next words. It is the 'plea' that so long as *A* is one thing and *B* another, neither can come to be 'in' the other, because then one thing would also be two things. Thus translate, 'but the claim of that which truly is has the support of the true and scientific plea that so long as *A* is *A* and *B* is *B*, neither will ever come to be in the other so that they become at once one and two'. The *αἰσθητόν does* 'come to be' in something other than itself, viz. in the *ὑποδοχή*, and this gives rise to the crude conception of the ordinary 'absolutist' view that a certain something, a quantum of space, and another something, the body which 'occupies it' are 'in the same place'. A 'geometrical point' of absolute space and a 'material point' of a body occupying it seem to be distinct and yet to be the same point. But this is regarded by Timaeus as a proof that *αἰσθητὰ σώματα* have no claim to an *οὐσία* of their own, and are only *γιγνόμενα*. A modern philosopher might quite well interpret the meaning of the sentence to be that what is 'in space' properly and primarily is 'events', and that 'objects' can only be said to be extended in a derivative and secondary way because they are connected with 'events' which are extended, much as the *Phaedo* uses spatial language about the 'occupation' of sensible things by Forms. (In fact this is exactly what Dr. Whitehead does say.) It would be unhistorical to credit either Timaeus or Plato with the origination of the 'theory of relativity' on the strength of such a coincidence, but the coincidence itself is real. It is really meant that whatever is 'in space' or 'in time' is one of the events which make up the 'passage of nature', and that what does not 'pass' is not extended in space either.

The question has sometimes been raised whether what Timaeus means throughout this passage by *χώρα* is 'perceptual' space or 'conceptual' space. Such a question cannot be answered without a preliminary attempt to give a more definite meaning to both these phrases than is commonly attached to them. If by 'perceptual' space be meant the first crude impressions of extension which (on the 'nativistic' theories of space-perception) we receive through the eye or the skin, this is not what Timaeus is speaking of as *χώρα*, for he denies that *χώρα* is apprehended through sense at all, and he insists on its uniformity. It is thus space as a geometer thinks of it, space as a uniform 'three-way spread' that he

has in mind.[1] We should do no violence to his description if we said that he means space as defined by the aggregate of the postulates of Euclidean geometry. This is exactly the 'timeless space' with which the physicist deals (unless he adopts a non-Euclidean set of postulates). It is what Newton called 'absolute' time and mathematical space, and what Leibniz had equally in view when he defined space as the order of co-existences. The precise link of connexion between it and 'perceptual' space seems to me to have been made clearer than before by Dr. Whitehead's treatment of the subject, which enables us to say exactly what such an 'absolute space' means. We start from the consideration that in our direct perception of the passage of nature temporal and spatial extension are inextricably bound up. Any system of measuring the one inevitably implies a definite way of measuring the other. This disposes of the possibility of regarding one and the same time order as *the* order of succession or one and the same space order as *the* order of co-existence in nature. Yet the notions of 'true mathematical' space and time have a real meaning, though not quite the meaning the old definitions suggest. The full concrete fact is the 'passage of nature' itself, and of this *all* space-time systems are perspectives. Each of us begins his own perception of nature with what may be called 'momentary' spaces. Space, as he takes it in at a given moment, is just a whole of existence given at that moment. It then becomes a problem how to connect together the numerous successive momentary spaces of each observer, and also those of different observers into one coherent system, as must be done if there is to be practical co-operation between men, and still more if there are to be such sciences as geometry and mechanics. Dr. Whitehead has shown very subtly in detail how this may be effected. It is possible to set up such a correlation between the various momentary spaces connected with instants of the *same* time-system that every point in one such momentary space corresponds to one and only one point in any other. To take a simple example: imagine a railway train moving, as an observer outside it says, in a certain direction with a uniform speed of sixty miles an hour. What appears to a person sitting in the train and therefore moving with it to be a stationary point appears to a person standing outside and watching the train continuously as

[1] Cf. the following remarks of Whitehead (*Principles of Natural Knowledge* pp. 137–8): 'There are three different types of meaning which can be given to the idea of "space" in connexion with external nature: (i) There is the four-dimensional space of which event-particles are the points and the rects and point-tracks and null-tracks are the straight lines . . . (ii) There are the three-dimensional momentary (instantaneous) spaces in the moments of any time-system a, of which event-particles are the points and rects are the straight lines. The observed space of ordinary perception is an approximation to this exact concept. (iii) There is the timeless three-dimensional space of the time-system a, of which point-tracks are the points and matrices include the straight lines. This is the space of physical science.'

It is (iii) of which Timaeus is talking, (i) is the four-dimensional space-time with which we have recently been made familiar; 'perceptual' space should in strictness mean (ii), but the philosophers who use the expression commonly overlook the point that there is a different 'space' of this kind for every instant of a given time-system, and thus are imagining an *Unding* which is neither (ii) nor (iii), but a medley of the two.

a rectilinear track of points. If you suppose a number of observers planted out along the line on which the train is travelling, and each limited to an instantaneous glance as the train passes him, this point-track appears in the momentary space of each of these observers as a single point. In virtue of this correspondence, we can mentally construct *one* timeless space for all observers with the same time-system, in such a way that the group of point-tracks of this time-system forms the group of points of the timeless space associated with the system.[1] It is this timeless space associated with a definite time-system which is the space explored by a geometer or physicist. Thus 'absolute position' turns out to mean something after all. It means position in the timeless space connected with a definite time-system. This is the space which Timaeus really has before his mind, and it is what ought to be meant by the modern philosophers when they speak of 'conceptual' space. (For a full explanation see Whitehead *Concept of Nature*, Lecture V, 'Space and Motion', pp. 99–119.) As for what does not 'pass', the 'eternal', Timaeus asserts that it is not 'in' anything except in the sense that it is 'in' itself, it 'fills' itself. So Milton is affirming the eternity of νοῦς when he says that the mind is its 'own place'.[2]

For a statement of Aristotle's theories about time and space and a comparison of them with the views of Timaeus see Appendix III.

52 d 2—53 c 3. Οὗτος μὲν οὖν . . . συνέψεσθε. The transition from the account of 'space' to the geometrical construction of the Empedoclean 'roots' is now to be made. But first we have to form an idea of what the filling of space would be like if the ultimate corpuscles had no definite geometrical structure. Unless we try to do this we shall not see how it is required by the principle of the 'best' that the ultimate types of corpuscles should be few and have a regular geometrical structure. Accordingly he tells us to think of space as filled with all sorts of sense-data subject to no recognizable law and executing 'random' movements. The contents of the 'receptacle' will then be a confused medley in which there is no equilibrium (*ἰσορροπία*) anywhere. The random movements of the contents make the 'receptacle' which holds them vibrate irregularly, and this vibration in turn complicates the movements of the contents. The general effect would be like that of passing seeds of different sizes through a twirling sieve in which the meshes are of different sizes. The tendency would be for particles of the same character to be sorted into the same heap. Thus 'before the universe was made' (53 c 7) there was already a tendency for like particles to be assembled together in distinct regions of space, and we shall find that this tendency continues in the actual

[1] Cf. Whitehead *Principles of Natural Knowledge* c. 11, pp. 128–38.

[2] Timaeus Locrus 93 a ff. opens with a brief abstract of the whole passage, 48 e 2—51 d 1, which, however, has no real value as it interprets the whole in terms of the Aristotelian physics and logic. *χώρα* is equated, as by Aristotle, with *ὕλη* (94 a *τὰν δ' ὕλαν ἐκμαγεῖον καὶ ματέρα τιθάναν τε καὶ γενετικὰν εἶμεν τᾶς τρίτας οὐσίας*, and *ποταγορεύοντι δὲ τὰν ὕλαν τόπον καὶ χώραν*). The statement that *χώρα* is apprehended by *νόθος λογισμός* is explained by saying that it is thought of *μήπω κατ' εὐθυωρίαν* (not directly) *ἀλλὰ κατ' ἀναλογίαν*, a mere perversion of Plato's meaning. Chalcidius also makes his interpretation of this part of the dialogue of none effect by trying to identify the *ὑποδοχή* with the Stoic *ἄποιος ὕλη*, body without quality.

universe and, if it were not counteracted by God or νοῦς, would disintegrate it. The first step taken by God in making a good universe out of the medley was naturally to reduce the particles to a number of definite shapes, those shapes being selected which are most adapted to produce a system which is 'the best possible'. We must therefore proceed at once to the enumeration and description of these shapes.

When Timaeus says that ὄν and γένεσις and χώρα were there 'even before the birth of the οὐρανός (καὶ πρὶν οὐρανὸν γενέσθαι, 52 d 4), and that the sifting process was going on, πρὶν καὶ τὸ πᾶν . . . διακοσμηθὲν γενέσθαι, 53 a 7, his words are not to be taken literally. All through his discourse οὐρανός and τὸ γενόμενον have been treated as synonymous; nature is just what 'passes', γίγνεται, and there would be no sense in talking about a 'passage', γένεσις, which was there before there was any nature. We cannot even, with Plutarch, take him to mean that there once was purely random and chaotic 'passage' as opposed to 'passage' which exhibits law and order, since he has told us that 'time came to be *along with* (ἅμα) the οὐρανός'. Again, the language about the action of the contents of the ὑποδοχή on the ὑποδοχή itself, which 'shakes it' (53 e 4), is purely mythical. The very account of the uniformity of the ὑποδοχή which Timaeus has just given would be contradicted if it were seriously meant that it *interacts* differently with its contents in different regions, to say nothing of the singular mechanics implied in the assertion that it is the rain of the particles which first sets the sieve twirling. The completely homogeneous ὑποδοχή can no more have motions of its own than a shape of its own. We ought rather to take the picture simply as a description of what would be the state of things if there were no definite structure of the corpuscles of body and no rhythmical periodic motions. T. means that if there were nothing but a medley of mechanically and chemically unstable bodies executing 'random' motions, certain consequences, which he describes, would follow.[1] All through the account of the imaginary chaos there is a tacit current of criticism of certain early ideas of the physicists. The main point is that a multitude of such chaotic movements, without the direction of intelligence, could not issue in the formation of what we call an οὐρανός or κόσμος, a system which is in stable equilibration (ἰσορροπεῖ) and marked by the prevalence of periodic rhythms of movement. This is a criticism on the earlier physicists generally, who had regularly accounted for the formation of οὐρανοί as the mechanical effect of a δίνη or 'eddy' set up in some region of the primitive boundless. What they never explain is how this could possibly bring about the ordered system we see actually existing with its great periodic rhythms. T. holds, in fact, that the uncontrolled working of the δίνη would be bound to have a very different result. Anaximander and Anaximenes believe that in some way οὐρανοί are formed in the 'boundless', but they have no account to give of the process.

[1] Cf. A. Levi *Il Concetto del Tempo nei suoi Rapporti coi Problemi del Divenire e dell' Essere nella Filosofia di Platone* p. 106: 'quel movimento disordinato non è dunque altro che la caratteristica essenziale del principio del divenire, dell' *ananke*, che il Demiurgo ordina, ma non distrugge: è l' aspetto irrazionale, irriducibile del mondo della genesi'.

Anaximander says that it is an 'eternal motion' by which 'opposites' are sorted (*ἐκκρίνεται*) out of the 'boundless' and blended together; Anaximenes holds that a relatively stable world-system is produced by the 'packing' or 'felting' of the original *ἀήρ*, but neither can explain how a mere primitive *δίνη* could work so as to effect the 'sorting out' or the 'packing'. (For the *δίνη* in Anaximander and Anaximenes see *EGPh.*[2] 61, 66, 77.) Anaxagoras (Fr. 12, R. P. 155) makes *νοῦς* produce an ordered world of things out of the original medley in which 'all things' were 'together' and 'indistinguishable' (Fr. 1, R. P. 151) by merely setting up a *περιχώρησις* which is just the *δίνη* over again. So Empedocles finds it absolutely necessary for his cosmology that at the moment when the formation of the 'heavens' begins the great masses of the 'four roots' shall be moving in certain specific directions, but he never explained why at the critical moment these movements should be taking place in just the suitable directions; he only said that 'it fell out so' (Fr. 53, R. P. 171 a, *EGPh.*[2] 233). Plato himself raises the same point at *Laws* x. 889 b 1. Speaking of the early physicists in general, though the language shows that it is Empedocles who is uppermost in his mind, he says 'they say that there are fire and water and earth and air, and that all these are by nature and chance and none of them by design (*τύχῃ φασίν, τέχνῃ δὲ οὐδὲν τούτων*), and further that the bodies which come after them—the earth, the sun, the moon, the stars—have been produced by these ⟨four⟩, though they are wholly destitute of *ψυχή*. As each of them was carried along on its random path (*τύχῃ δὲ φερόμενα τῇ τῆς δυνάμεως ἕκαστα ἑκάστων*) they somehow fitted in appropriately when they came together (*ἤ συμπέπτωκεν ἁρμόττοντα οἰκείως πως*), hot with cold, dry with moist, soft with hard, and so with all the combinations which inevitably arose from the fortuitous blending of the opposites, and that is how the whole *οὐρανός* and everything in it, and actually all animals and plants, came to be, for all climates (*ὡρῶν*) arose from these causes, not (so they say) by the agency of mind or a god or by design, but as I said by nature and chance'. Plato complains that the effect of such theories has been to encourage a secularistic and atheistic moral attitude to life. His point, like that of Timaeus here, is that 'evolution without guidance' is insufficient to explain the formation of an orderly world. This was also why Socrates at first admired Anaxagoras so much, because in words, at any rate, Anaxagoras said that it was *Mind* which set up the movement by which a *κόσμος* is formed, though Socrates was shocked to find that he was not alive to the implications of his own statement. He never said that it implies that things are ordered 'as it is good they should be', and so he made no further use of his principle but assigned purely physical causes (airs and waters) for everything, like the rest of the *φυσικοί* (*Phaedo* 97 c—98 c). Aristotle simply reproduces this criticism. Anaxagoras, he says, uses Mind like a *θεὸς ἀπὸ μηχανῆς*, a 'fairy godmother', to get the formation of a *κόσμος* started, but does nothing more with it. (*Met.* 985[a] 18 *Ἀναξαγόρας τε γὰρ μηχανῇ χρῆται τῷ νῷ πρὸς τὴν κοσμοποιίαν καὶ ὅταν ἀπορήσῃ διὰ τίν' αἰτίαν ἐξ ἀνάγκης ἐστί, τότε παρέλκει αὐτόν, ἐν δὲ τοῖς ἄλλοις πάντα μᾶλλον αἰτιᾶται τῶν γιγνομένων ἢ νοῦν.*) T.'s real point is the same. An unguided evolution from a primitive confusion, due to the

working of a δίνη, ought rather to lead to a 'dead level' than to the formation of a 'world' of varied and yet orderly motions. Cf. the line of criticism adopted in Ward's *Naturalism and Agnosticism* on the very similar attempt of H. Spencer in his *First Principles* to get the world as we know it, without guidance of any kind, out of an absolutely homogeneous rotating nebula.

The state of chaos which Timaeus describes is exactly the condition of things assumed by Empedocles for the initial moment of the period in his cycle when 'strife' is coming back into the world and driving out 'love' (the period in which we are supposed to be living). You start with the 'roots' all so closely intermingled that they form what Empedocles called the 'sphere', a compact *plenum* in which 'there are distinguished neither the swift limbs of the sun, nor the shaggy earth in its might, nor the sun' (Emped. Fr. 27, *Fr. d. Vors.*[3] i. 237 = R.P. 167 ἔνθ' οὔτ' Ἠελίοιο διείδεται ὠκέα γυῖα | οὐδὲ μὲν οὐδ' αἴης λάσιον μένος οὐδὲ θάλασσα). Strife gradually breaks up this amalgam, until, at the opposite point of the cycle, all the earth is separated off together into one region, all the water into a second, all the air into a third, all the fire into a fourth. The formation of our world of definite compounds of the 'roots' is an episode in this process. The *initial* state of things assumed by Anaxagoras is very similar to the first of these two extreme stages in Empedocles' cycle. (Anaxag. Fr. 1, *Fr. d. Vors.*[3] i. 399 = R. P. 157; Fr. 4, *Fr. d. Vors.*[3] i. 400 = R. P. 151.) Until νοῦς starts a rotation somewhere in the original mass, all the infinitely numerous and various molecules of which the mass is made up are blended into a confused aggregate which looks like a medley of fire and air because there happen to be more molecules of them than of anything else. The περιχώρησις set up by νοῦς leads mechanically to the 'sorting out' of an ordered κόσμος. Democritus also *seems* from the accounts of him in Aristotle and Theophrastus to have started in his account of the formation of a κόσμος from a medley of 'indivisible bodies' of all sorts of different sizes and shapes moving in all directions and perhaps with all velocities.[1] But once more there is no reason to suspect any specific reference to Democritus.

[1] The evidence is briefly as follows. Democritus certainly did not, like Epicurus, ascribe to the atom a 'natural' or primary movement in one fixed direction, 'down'. This is why Aristotle says that neither he nor Leucippus had explained what is the 'natural motion' of an atom (*De Caelo* Γ. 300 b 8 διὸ καὶ Λευκίππῳ καὶ Δημοκρίτῳ, τοῖς λέγουσιν ἀεὶ κινεῖσθαι τὰ πρῶτα σώματα ἐν τῷ κενῷ καὶ τῷ ἀπείρῳ, λεκτέον τίνα κίνησιν καὶ τίς ἡ κατὰ φύσιν αὐτῶν κίνησις. It follows that the Atomists had said nothing about that of 'free atoms'. Now what Aristotle has in mind when he talks of a κατὰ φύσιν κίνησις is just his own theory that some bodies tend when 'free' to move 'up' and others 'down', others (the 'spheres') to rotate. We may infer that the Atomists did not regard motion in a specified direction as inherent in the 'free' atom, and therefore that atoms coming into the δίνη are moving in all sorts of directions. As for the other point, Theophrastus definitely says (*de Sensu* 61, *Doxogr.* 516 = R. P. 199) βαρὺ μὲν οὖν καὶ κοῦφον τῷ μεγέθει διαιρεῖ Δημόκριτος, and Aristotle (*de Generat. A.* 326[a] 9) βαρύτερόν γε κατὰ τὴν ὑπεροχήν φησιν εἶναι Δ. ἕκαστον τῶν ἀδιαιρέτων. Bt., who discusses these testimonies at *EGPh.*[3] 341–4, seems to me right in holding that this refers to the movement of atoms *in* the δίνη, the greater weight of the larger atom meaning simply its ability to make its way towards the centre of the eddy. Apparently nothing was said about the velocity of a 'free' atom. If it had been stated that all 'free' atoms have the same velocity, Aristotle could hardly have complained that the Atomists had left the question of their κατὰ φύσιν κίνησις wholly undecided.

The general theory of the atom's motions is ascribed by Aristotle to 'Leucippus and Democritus' in common; the criticisms of Timaeus are not directed against anything peculiar to Atomism but against a common presupposition of the physicists in general; if he is thinking of any one in particular it is probably Empedocles.

52 e 1—53 a 2. **διὰ δὲ τὸ μήθ' ὁμοίων . . . ἕδραν.** The consequences of the random motions in a chaotic medium, i.e. the workings of a *δίνη*, would be exactly what we see when seeds of different sizes are put into a sieve with holes of different sizes and shaken up by twirling the sieve at random. Most of the smaller seeds find their way out through the small holes, the larger continue to be shaken up and down until they make their escape through the larger holes. Thus, in the aggregate, the result is that the different seeds are sorted into heaps in such a way that those of about the same size are in the same heap, and this is why a sieve of this kind is used in winnowing grain. T.'s point is that *this* is the only result you could expect from a *δίνη*. If you started with the compact mass Empedocles calls the 'sphere', you would no doubt arrive at something very closely like the state of things he describes as its antithesis, the separation of the contents of space into separate fairly homogeneous layers. But you would not pass through the development of a systematically organized and relatively stable *κόσμος* on the way, as Empedocles supposed.

52 e 3. **ἰσορροπεῖν.** On the notion of *ῥοπή* in Greek physics see *EGPh.*[2] 344–5.

53 a 1. **ἀνικμώμενα.** *ἀνικμᾶν* was evidently a rare word. Apart from this passage it appears not to occur in extant literature, but is explained in lexicographical glosses as equivalent to the more familiar *ἀναλικμᾶν*, a clear proof that the glossators knew of its occurrence. Hence F which preserves it, and A which shows traces of having originally read it, must be presumed to indicate the genuine text. In their lost archetype *ἀναλικμώμενα* may have stood in the margin. The use of the implement described by Timaeus is that it enables you to sift out grain of more kinds than one at once. Democritus used the same illustration to explain how in an 'eddy' or 'vortex motion' of atoms those of like shape and size are brought together, the biggest tending to the centre of the eddy, the smallest being forced out to the circumference. He added a similar illustration from the way in which a pebble beach is formed; 'long pebbles cluster with long ones and round ones with round ones'. He even drew a further fanciful parallel from the attraction of like for like among animals in virtue of which 'birds of a feather flock together'. (Democrit. Fr. 164, *Fr. d. Vors.*[3] ii. 93 = R.P. 196 a *καὶ γὰρ ζῷα ὁμογενέσι ζῴοις συναγελάζεται, ὡς περιστεραὶ περιστεραῖς καὶ γέρανοι γεράνοις . . . (ὡς) δὲ καὶ ἐπὶ τῶν ἀψύχων, καθάπερ ὁρᾶν πάρεστιν ἐπί τε τῶν κοσκινευομένων σπερμάτων καὶ ἐπὶ τῶν παρὰ ταῖς κυματωγαῖς ψηφίδων κτλ.*) A.-H., who refers to this parallel, is probably wrong in trying to suggest that Democritus saw no mechanical reason for the fact. The reason is that the smaller atoms, when they are caught in the eddy, are less able to retain their original motion unaffected by the bombardments to which they are exposed. The bulky ones retain their original motion better,

and so keep on until they get into the middle of the vortex. (See *EGPh.*[2] 346 where it is pointed out that this is apparently what is meant by the *ἀντέρεισις τοῦ μέσου* ascribed by Diogenes Laertius to Leucippus the founder of Atomism.) It is therefore quite likely that the illustrations of the process by the winnowing-sieve and the formation of the pebble beach go back to Leucippus too, and the use of one of them here is thus not a convincing proof that Plato was acquainted with the works of Democritus (cf. *EGPh.*[2] 331).

53 a 3. δεξαμενῆς so accented is the reading of AY against the δεξαμένης of F. A.-H. thinks this reading of A wrong and adopts δεξαμένης (not knowing anything about F). I think his reasons very unconvincing. In the places where the word δεξαμενή occurs in extant literature it is used of a 'cistern' for water.[1] But its etymology shows that the literal sense is simply a 'receiver', so that it is rash to assume that it could not have been used for a receptacle for other things than water. With the other reading we should have to explain why the participle is feminine and not neuter by supposing that this is due to the gender of τιθήνη at 52 d 5, the metaphor of the τιθήνη still lingering in the speaker's mind. This seems hard to accept, and the *tense* of the participle would surely be wrong. Since there is no question of an originally empty receptacle into which things were afterwards conveyed, we ought at least to have τῆς δεχομένης, 'that which holds them', not τῆς δεξαμένης, 'that into which they were put'. Hence I think St. Bt. and other editors who read δεξαμενῆς are right.

53 a 7. πρὶν καὶ τὸ πᾶν . . . γενέσθαι. This criticism, though it would apply to the φυσικοί in general, is obviously meant to have a special point as against Empedocles. T. means that the consequence of random eddies occurring at 'arbitrary' points in space would be analogous to the consequence of shaking the 'differential' sieve and its contents about at random. It would set up a steady progressive sorting out of the molecules of different shapes and sizes, so that those of a kind were steadily 'dumped' in the same region, and the separation would actually be effected 'before the ordered whole could be formed'. The special point is that Empedocles expressly taught that our *actual* ordered world, which has arisen as strife is gradually disintegrating the 'sphere' (*EGPh.*[2] 235), is an episode in just such a process of 'sifting'. Timaeus urges that the sifting would have run its whole course before an ordered world could arise; the ordered and relatively stable 'heterogeneity' of things as we know them cannot be a mere episode in the steady dissociation of a medley into sets of homogeneous components. It could only be produced by 'evolution under intelligent guidance' working towards an end. And that means that God has to be taken into account. This is why we are told at once in 53 b that as a first step towards securing such a world the 'roots' must be given a definite and fixed structure. They must be

[1] For examples of the word see the new L. and S. s.v. It is a favourite with Philo, who repeatedly uses it, not only of actual cisterns, but e.g. of the female breast as supplying milk, e.g. *de caritate* 18 γάλα, ὃ διὰ μαστῶν τῆς τεκούσης ὡς ἐκ δεξαμενῶν φέρεσθαι διετάξατο. Philo's fondness for the word is probably due to a recollection of the present passage. His vocabulary is full of such echoes of the *Timaeus*.

endowed with the type of structure which makes their combinations stable. It cannot be a mere accident that out of all possible varieties of structure the rudimentary bodies should have just those which are adapted to the formation of a world of stable compounds. The antecedent probability of this, if we suppose it not to be *designed*, is infinitely small. Therefore we must look on the result as due to intelligent design. You might put T.'s point in this way. If there are an infinite number of logically possible distributions of 'matter and motion' over space, but only a few of them could give rise to a stellar system capable of persisting for an appreciable time, the question at once arises, can we regard it as a mere unaccountable fact that the distribution which actually existed at the beginning of our 'stellar universe' was one of those few and not one of the infinitely more numerous distributions incompatible with the formation of a stable 'stellar universe'? Must we not infer that this is really a case of *selection* by an intelligence with a purpose before it? T. and Plato think that we must. (It does not occur to either to examine the possibility that the actual *οὐρανός* is only one out of a vast number of 'nature's' random experiments, all traces of the rest having vanished because they were 'misses'.)

53 a 8. ἀλόγως καὶ ἀμέτρως. As the conjunction of words shows, *ἀλόγως* means 'without ratio'. In the medley imagined by Timaeus there are no fixed ratios or measures determining the structure or movement of the constituent particles; it is like a chaos of chemical combinations without any law of combination in definite proportions and without any fixed 'atomic weights' for the 'elements'.

53 b 1. ἐπεχειρεῖτο. The word must be passive, as the middle of the verb seems never to occur, but this makes the sentence a little awkward, since the subject of *διεσχηματίσατο* has to be an 'understood' *ὁ θεός*. *πῦρ, ἀέρα* are properly the object accusatives after *διεσχηματίσατο*, but owing to the interposition of the long clause *παντάπασι . . . θεός* the object is resumed by *ταῦτα* in b 4, and the nouns *πῦρ, ἀέρα* get the appearance of being outside the construction. This kind of 'anticipatory' accusative is a very common feature of Plato's latest style, e. g. in the *Laws*.

53 b 2. ἴχνη μὲν ἔχοντα αὑτῶν ἄττα. That is, as yet we must not think of the corpuscles of these four 'roots' as having the very exact geometrical structure which is directly to be described. That exactness is introduced by *νοῦς* or God with a view to an end. But the particles of the medley fall into four main groups imperfectly exhibiting the shapes which are going to be assigned to the four 'roots'. They approximate to being earth, fire, &c., and it is suggested that the approximation is not very close. Still the medley would present something *like* the 'sphere' of Empedocles, the compact mass of the four 'roots' when they have all been brought together by *φιλία*. We may remember the state of things from which Anaxagoras starts, when all 'things' were 'together' and gave the general appearance of being an amalgam of fire and air because there was more fire and air than anything else in the mass. (Fr. 1, *Fr. d. Vors.*[3] i. 399 = R. P. 151 *πάντα γὰρ ἀήρ τε καὶ αἰθὴρ κατείχει, ἀμφότερα ἄπειρα ἐόντα· ταῦτα γὰρ μέγιστα ἔνεστιν ἐν τοῖς σύμπασι καὶ πλήθει καὶ μεγέθει.*) We might illustrate by conceiving our chemical 'atoms' with their

definite atomic weights as an 'evolution' from a state of things in which there was as yet only a 'tendency' to this sharp and precise discrimination.

53 b 5. εἴδεσί τε καὶ ἀριθμοῖς. The *εἴδη* are the geometrical shapes of the particles, which are about to be described: a sense of *εἶδος* which still survives in Euclid in stereotyped phrases like *ἐλλεῖπον* or *ὑπερβάλλον τετραγώνῳ εἴδει*, 'falling short of' or 'exceeding' a given area 'by a square figure'. As for the *ἀριθμοί* they are clearly the numerical formulae by which the different *εἴδη* are determined. To judge from the descriptions of these *εἴδη* in the sequel, what is directly meant is probably the number of faces and angles of each of the *εἴδη*. But, as we shall see, there are also still simpler numerical formulae determinative of the two ultimate triangles out of which the faces of the solid figures, and so in the end the figures themselves, are constructed. These formulae, too, would come under the general expression that God 'laid out' the 'roots' by figure and number.

53 b 7. ὡς δεῖ τοῦτο λεγόμενον ὑπαρχέτω. That is, let it be said now at the beginning of our narrative once for all and borne in mind as a standing assumption at every succeeding step. We do not want to have to repeat it at every fresh step, so it is as well to say now that the principle holds good of every stage of the 'evolution'. Contrast the spirit of the alleged reply of Laplace to Napoleon's question why he had never mentioned the Creator in the *Mécanique céleste*, 'Sire, je n'avais pas besoin de cette hypothèse-là'. Timaeus is of the opinion that if 'cette hypothèse-là' is not to be invoked to explain each particular fact of nature, the reason is that it applies equally to them all.

53 c 1. ἀήθει λόγῳ. The doctrine of the corpuscular structure of the 'roots' now to be expounded presupposes a knowledge of the construction of the 'regular solids'. The construction of the figures geometrically, and what is virtually the same thing, their inscription in the sphere, was the crowning achievement at which the Pythagorean creators of scientific geometry were aiming. This is why that is the task with which Euclid completes his survey of elementary geometry in the 13th book of his *Elements*. How definitely the work is arranged to lead up to this denouement appears from the fact that there is a whole string of problems running through the *Elements* which has no purpose except to prepare the way for the inscription of the dodecahedron at xiii. 17. Thus at ii. 11 Euclid shows how to make the so-called 'golden' section of a straight line. This is only wanted because it is a step to the construction (iv. 10) of an isosceles triangle with each of the equal angles double of the remaining angle. iv. 10 again has no use except as a step to the inscription of the pentagon in the circle (iv. 11), and the inscription of the pentagon again is wanted only because the faces of the dodecahedron are pentagons, and the first thing to be done when we come at last to inscribe the dodecahedron in the sphere is to inscribe a pentagon in a circle. The ancient tradition, presumably going back to Eudemus, is that the Pythagoreans had solved the problem for three of the five regular solids, the cube, tetrahedron, and dodecahedron, but the construction and inscription of the other two, the octahedron and icosahedron, was dis-

covered in the Academy by Theaetetus, and that this is why the five solids came to be known as the σχήματα Πλάτωνος. (Scholia in *Euclid. Element.* xiii, ed. Heiberg v. 654 τρία δὲ τῶν προειρημένων ε̄ σχημάτων τῶν Πυθαγορείων ἐστίν, ὅ τε κύβος καὶ ἡ πυραμὶς καὶ τὸ δωδεκάεδρον, Θεαιτήτου δὲ τό τε ὀκτάεδρον καὶ τὸ εἰκοσάεδρον. τὴν δὲ προσωνυμίαν ἔλαβον Πλάτωνος διὰ τὸ μεμνῆσθαι αὐτὸν ἐν τῷ Τιμαίῳ περὶ αὐτῶν.) *Elements* xiii seems, in fact, to be simply a compendium of the work of the Pythagoreans and the Academy. As the writer of the Scholium just quoted says, ἐν τούτῳ τῷ βιβλίῳ . . . γράφεται τὰ λεγόμενα Πλάτωνος ε̄ σχήματα, ἃ αὐτοῦ μὲν οὐκ ἔστι —here follow the words just quoted—Εὐκλείδου δὲ ἐπιγράφεται τὸ βιβλίον διὰ τὸ στοιχειώδη τάξιν ἐπιτεθεικέναι καὶ ἐπὶ τούτου τοῦ στοιχείου. Everything points to the trustworthiness of the tradition. That the Pythagoreans should have discovered the construction of the dodecahedron—the most difficult of the five—is natural when we remember their peculiar interest in the pentagon. The version of the legend of Hippasus which makes his offence against the Order the divulgation of this very construction points in the same direction. It is no real objection to say that the constructions expressly ascribed to Theaetetus are not so difficult as that of the dodecahedron. If the Pythagoreans did not discover them, the reason may be simply that they were not *interested* in the octahedron or icosahedron. (Euclid follows up the five inscriptions at once by the proposition that there are no regular figures except these five which can be 'inscribed', and this suggests that the real originality of Theaetetus may have been that he was the first to raise this question and that it may have been the raising of it which led to the discovery that there are octahedrons and icosahedrons. The cube is a familiar figure enough to any people who are acquainted e. g. with dice, the tetrahedron suggests itself at once to any one who has realized, as we know the Pythagoreans had, that four points not all in one plane are the fewest which determine a figure in three dimensions, the dodecahedron to any one familiar with the construction of balls out of twelve pentagonal pieces of leather, but there is no special reason why any one but a man who had raised and solved the general problem of the number of the 'regular' solids should think of the other two at all.) That solid geometry was regarded by Plato as not having been quite constituted as a science in the fifth century is indicated, as Bt. has noted, by the curious way in which it is mentioned by Socrates at *Rep.* vii. 528 b. He says there that he had just made an oversight when he proposed at 527 d that astronomy should be studied directly after geometry (i. e. plane geometry). Geometry of three dimensions ought to come between the two. Glaucon replies that that science seems not yet to have been invented (δοκεῖ οὔπω ηὑρῆσθαι, 528 b 4), to which Socrates rejoins that it soon would be invented if it received state support and if students had a director of their researches. He evidently means that a beginning has been made by individual inquiries, but that the subject has not yet been properly systematized. On the other hand, at *Epinomis* 990 d 8 the science is mentioned as a matter of course and has a recognized name στερεομετρία, as we should expect in a work written after the death of Theaetetus. The words ἀήθει λόγῳ may thus be a covert allusion to the fact that in letting Timaeus describe the icosahedron and

octahedron Plato is going a little beyond the bounds of exact historical accuracy. But Plato is careful to strain historical probability as little as possible. He cannot avoid making Timaeus speak of all the five figures, but he takes care never to make him mention the fact that they can all be inscribed in the sphere. He does refer to the inscription of the tetrahedron and by implication to that of the dodecahedron, but these two inscriptions were asserted by tradition to have been actually known to the Pythagoreans before Plato's day. Of course the words ἀήθει λόγῳ are relative to the date at which they are supposed to be spoken. Plato does not mean that the doctrine would be ἀήθης to the Academy in his own time.

53 c 1–3. ἐπεὶ μετέχετε ... συνέψεσθε. The words are very significant. They definitely mean that the audience, *including Socrates*, are abreast of the latest mathematical researches of this time and will therefore be able to follow the exposition. That Socrates was well at home in the higher mathematics of his time is a standing assumption with Plato. Thus at *Cratylus* 436 d 2, when he wishes to illustrate the far-reaching consequences of an apparently trifling initial mistake, he appeals at once, as the most familiar instance, to errors arising from a false geometrical diagram (ὥσπερ τῶν διαγραμμάτων ἐνίοτε τοῦ πρώτου σμικροῦ καὶ ἀδήλου ψεύδους γενομένου, τὰ λοιπὰ πάμπολλα ἤδη ὄντα ἑπόμενα ὁμολογεῖν ἀλλήλοις), exactly as Simmias dwells on the same point at *Phaedo* 92 d. In the *Theaetetus* (147 d ff.) he follows with high appreciation the account of the lecture which Theodorus has been delivering on irrational square roots; in the *Gorgias* (508 a) it is the language of mathematics which comes at once to his lips when he attempts to explain the true law of justice (ἡ ἰσότης ἡ γεωμετρικὴ καὶ ἐν θεοῖς καὶ ἐν ἀνθρώποις μέγα δύναται); in the *Meno* it is from a geometrical theorem that he undertakes to illustrate the doctrine of ἀνάμνησις (82 b—85 b) and to a geometrical problem and its solution that he turns when he wishes to give an example of the imposition of an initial condition or restriction on the discussion of a problem generally (86 e—87 c); in the *Republic* he discusses with complete familiarity the methods and limitations of the whole range of mathematical science as it existed in the fifth century, but it is even more significant that he incidentally and without any explanation uses such phrases as that about the 'rational' and 'irrational' diameters of 5 (*Rep.* viii. 546 c 4), which presuppose familiar knowledge of quite specific problems of what was in the fifth century 'higher' mathematics.[1] It has been often supposed that in

[1] The phraseology about 'rational' and 'irrational' diameters of certain numbers is connected with the definite problem of approximating to the 'square root of 2' or, as we should say, finding the successive 'convergents' to the value of the endless 'continued fraction' $1 + \cfrac{1}{2 + \cfrac{1}{2 + \cfrac{1}{2 + \textit{ad infin.}}}}$

The problem, which the early Greeks treated geometrically in a manner fully explained by Proclus (*in Remp.* ed. Kroll, ii. 24, 27–9; see the excursus and diagram by Hultsch ap. Kroll, op. cit. 393–400), is to find a series of positive integral solutions in x and y of the equation $y^2 = 2x^2 \pm 1$. The successive values of x thus obtained are called πλευραί and the corresponding values of y their διάμετροι because the successive fractions $y_1/x_1, y_2/x_2 \ldots y_n/x_n \ldots$ are increasingly close approxima-

all these places Plato is simply crediting Socrates with his own mathematical knowledge. But this ought to be incredible for several reasons. As Bt. has argued, the theory leaves it a mystery why in the *Republic* Plato should feel a difficulty about making Socrates recognize solid geometry as one of the sciences. Also we have the concurrent evidence of Aristophanes who laughs at Socrates in the *Clouds* for concerning himself with mathematical problems and makes a point of putting technical mathematical terms into the mouth of his μαθητής. (See the discussion of this in my *Varia Socratica* 153–6.) Finally there is the important passage of Xenophon (*Memorab.* iv. 7. 2 ff.) already mentioned, where, in the very course of an argument to show that Socrates did not encourage young men to devote themselves to 'useless' research, he twice makes the damaging admission that Socrates was himself not 'unversed' in advanced geometry and astronomy. Since Xenophon's 'case' is that Socrates was not a man of science at all but merely a preacher of practical utilitarian 'morality', the only important thing in this passage is the admission, which really ruins the main thesis, that Socrates was at home with the 'intricate diagrams' and the inquiries about the distances and orbits of the planets. He is obliged to make the admission in order to show that the disapproval of 'useless science' which he ascribes to Socrates was not the prejudice of mere ignorance. If we could be sure that Xenophon is here speaking from his own knowledge about the attainments of Socrates the passage would be an invaluable confirmation of Plato's representations. Unfortunately there is always the very real possibility that he is only basing his statements on what he had read in Plato, as seems often to be the case in the *Memorabilia*. He *may* even have had the *Timaeus* itself in his mind, as it seems likely that *Memorab.* Δ was a work of his old age. What is plain in any case is that Xenophon saw nothing inconsistent with his own memories of Socrates in such accounts of his scientific attainments as we get in Plato. (The 'utilitarian' tone of the advice he makes Socrates give to young men in general would be fully explained if Socrates had told Xenophon himself that it would be waste of time for *him* to specialize on geometry and astronomy, as it certainly would have been.) The translation of Chalcidius breaks off here.

53 c 4—55 c 6. πρῶτον μὲν δὴ . . . διαζωγραφῶν. The Construction of the four 'Roots'. The 'roots' are all bodies, and therefore have three dimensions. Solid figures are built up out of plane faces at angles to one another. Plane figures are themselves all resoluble into triangles. Thus the rectilinear triangle is the simple figure from which all others can be made. With a view to the perfection of the universe God selected as

tions to the ratio of the diagonal to the side of a square; they are, in fact, the successive 'convergents' to the 'continued fraction' mentioned above. The particular 'convergent' Socrates is thinking of in the *Republic* passage is the third, 7/5. (See the 'arithmetical' or 'algebraical' rule for the construction of the successive 'sides' and 'diameters' in Theo Smyrnaeus ed. Hiller 43–5.) The striking thing is that Socrates employs technical language which presupposes the whole construction without offering any explanation and apparently assumes that the whole audience understand it. Proclus (loc. cit., where he appears to be reproducing Dercylidas), and Theon (whose authority is the Peripatetic Adrastus), ascribe the whole theory to 'the Pythagoreans'

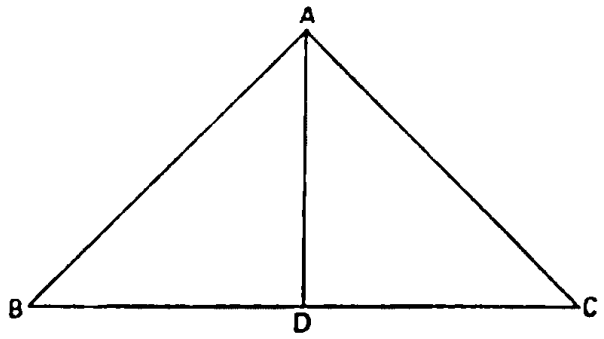
the two ultimate types of triangle from which to build up the roots the right-angled isosceles and that right-angled scalene triangle in which the hypotenuse is double in length of the shorter side. From the first He constructed the square, which is the face of the cube. From the second He made the equilateral triangle, and built up with equilateral triangular faces three regular solids, the tetrahedron, octahedron, icosahedron. These were adopted as the shapes of the particles of the four 'roots'. There is still a fifth regular solid (i. e. a solid whose faces are equilateral and equiangular rectilinear figures), but a different use was found for this.

53 c 4–6. **πρῶτον μὲν . . . ἔχει.** *σώματα, σώματος* are used here in the purely geometrical sense. The 'roots' are 'bodies' simply in the sense that they all have *βάθος*, 'depth', a third dimension. *τὸ τοῦ σ. εἶδος* is a mere periphrasis for *τὸ σῶμα*, 'bodies have depth'.

53 c 6–8. **τὸ δὲ βάθος . . . συνέστηκεν.** *βάθος*, 'depth', is bounded by a surface or surfaces (*ἡ ἐπίπεδος φύσις*). *τὴν ἐ. φύσιν* is the *subject* of *περιειλῆφέναι*. Strictly speaking *ἐπίπεδος*, as the derivation implies, means 'level', 'flat', so that *ἐπίπεδος φύσις* or *ἐπίπεδον* should mean '*plane* surface'. The later generic name in the geometers for surface as such, whether plane or curved, is *ἐπιφάνεια* (Euclid's word). Plato uses *ἐπίπεδον* both for 'surface' in general and for 'plane surface' in particular, and never uses *ἐπιφάνεια* in the technical mathematical sense. Aristotle (see Bonitz *Index Aristotelicus* s. v.) has the mathematical sense of *ἐπιφάνεια*, but also uses *ἐπίπεδον* for surface generally. If we suppose that *ἐπίπεδος* has its strict sense here, there may be an oversight. It is not true that every volume is enclosed by planes. The surfaces of a sphere, an ellipsoid, a cone are instances to the contrary. We must therefore suppose that Plato is using the word here in the wider sense, or else, and this is more probable, that Timaeus is thinking only of the 'regular' solids, the only solids which are to be employed in his construction. In that case he is speaking with a mental reservation which makes his statement true. In the phrase *ἡ ὀρθὴ τῆς ἐπιπέδου βάσεως*, *βάσεως* is a partitive genitive, the meaning being *ἡ ὀρθὴ ⟨βάσις⟩ τῆς ἐ. βάσεως*, where *ὀρθή* means rectilinear, formed by *ὀρθαὶ γραμμαί*, 'those plane faces which are rectilinear'—i. e. 'plane rectilinear figures'. Any rectilinear polygon can be divided up into triangles, but you cannot divide a triangle into figures with less than three sides each, *τὸ τρίγωνον ἔσχατον*, as Aristotle says.

53 c 8–d 4. **τὰ δὲ τρίγωνα πάντα . . . νενεμημένης.** *ἄρχεται* = 'begin with', 'have as their starting-point'. That is, any triangle whatever can be divided into right-angled triangles, and both of these right-angled triangles may be isosceles or both may be scalene. Thus, if *ABC* be a triangle, by dropping a perpendicular *AD* from *A* on *BC* you resolve *ABC* into the two right-angled triangles *ADB*, *ADC*. Then *BD* may or may not be equal to *AD* and similarly with *DC*. (The triangles *ADB*, *ADC* will not be isosceles unless the angle *BAC* is a right angle.) It is characteristic of Timaeus as a Pythagorean that he is determined that both his types of ultimate triangle shall be right-angled. In d 2 *μέρος* is used in the special sense of 'an equal part', 'a half'. If *ADB*, for

example, is an isosceles triangle with $AD = DB$, by Euclid i. 6 the angles BAD, ABD will be equal, and since by i. 32 the sum of the three angles is two right angles, and the angle BDA is a right angle by construction, each of the equal angles at A and B will be half a right angle. πλευραῖς ἴσαις in d 3 is a 'dative of the recipient', so that the literal translation of the phrase is 'the one has on each side half of a right angle which is divided to (shared out to) equal sides'. So in the following clause ἀνίσοις is a 'dative' of the recipient with νενεμημένης, 'the other has unequal parts ⟨of a right angle⟩ which is distributed between unequal ⟨sides⟩'. The isosceles triangle thus obtained has a fully determinate



shape, since its angles are all determinate (90°, 45°, 45°). All such triangles are therefore similar and only differ in magnitude. Hence Timaeus will directly select the isosceles right-angled as one of the two types of elementary triangle to be used in his constructions. In the case of the right-angled scalene triangles, since you can divide the 90°, which is the sum of the two unequal acute angles of such a triangle, into *unequal* parts in an infinite number of ways, there is an infinite variety of scalene right-angled triangles, none geometrically similar to another, and Timaeus has yet to decide on the particular scalene right-angled triangle which he will employ.

53 d 4. ταύτην. For τοῦτο by the usual assimilation to the gender of ἀρχήν. 'Let us postulate this ⟨property⟩ as the starting-point of fire, &c.' The ἀρχή meant is not the scalene right-angled triangle which has been the last thing to be mentioned, since we shall find that one of the ἄλλα σώματα has the isosceles right-angled triangle as its basis; the ἀρχή is the resolubility of any triangle into right-angled triangles.

53 d 5–6. ὑποτιθέμεθα . . . πορευόμενοι. We 'postulate' that we are to proceed in this fashion and the whole construction belongs to the realm of εἰκότες λόγοι. T. does not offer to *prove* his theory about the forms of the corpuscles of the 'roots', nor does he regard it as self-evident. He is prepared, as he says a little later, for the possibility that the whole thing may turn out to be a merely 'provisional' account, but he *postulates* his resolution of the corpuscles into triangles of the two types, according to the rules of the method as described in the *Phaedo*, for the purpose of examining the συμβαίνοντα which follow from it. He holds that by the 'assumption' that the particles of the 'roots' have certain definite shapes which can be geometrically constructed out of these triangles he can 'save', that is, do justice to, the 'appearances' as he knows them. But he is well aware that his knowledge of the 'appearances' is only imperfect.

As he says, he is merely following *τὸν εἰκότα μετ' ἀνάγκης λόγον*. The *ἀνάγκη* lies in the cogency with which his conclusions follow from his 'postulate'; if you admit the 'postulate', you cannot get away from the results deduced from it. But the actual 'postulate' of the regular solids as the forms of the particles, and of the particular way of building up these solids from just these two elementary triangles, is based on nothing more than a geometer's sense of what is aesthetically 'fit', and has therefore to be regarded as a 'likely account' and no more. As T. himself says, at 54 a 5, if any one will produce a better theory, he will look on its triumph as that of a friend. When the Greeks are charged with an unscientific readiness to accept whatever satisfied their sense of aesthetic fitness it is only fair to remember that this cannot justly be said of Plato, who expressly regards such assumptions as 'likely stories', not as demonstrated truths, and insists repeatedly on the provisional character of all cosmological hypotheses.

53 d 6–7. *τὰς δ' ἔτι τούτων . . . φίλος ᾖ.* Timaeus offers no explanation of this hint that there are 'starting points' even more ultimate than the triangles, and that these are known only to God and to men who are God's friends (i.e. philosophers). We can therefore only conjecture his meaning, but I think a reasonable conjecture may be made. If we remember that Timaeus is a Pythagorean and that the ultimate *ἀρχαί* of the Pythagoreans were *πέρας* and *ἄπειρον*, it at once occurs to us that to 'begin at the very beginning' we should expect to be told in what way the two triangles behind which Timaeus never attempts to go in his cosmology are themselves produced from *πέρας* and *ἄπειρον*. The genesis of the triangles should be the topic on which he either cannot explain himself further or does not choose to do so. If we follow up this thought we may be led to a very interesting result. We know that the Pythagorean view was that the first result of the combination of *πέρας* and *ἄπειρον* is the formation of the unit (*μονάς*) or number 1, and that the next step is the production of the series of numbers (i.e. integers) by repetition of the 'unit'. Cf. Aristot. *Met.* 986^{a} 17 *τοῦ δ' ἀριθμοῦ στοιχεῖα τό τ' ἄρτιον καὶ τὸ περιττόν, τούτων δὲ τὸ μὲν ἄπειρον, τὸ δὲ πεπερασμένον, τὸ δ' ἓν ἐξ ἀμφοτέρων εἶναι τούτων, καὶ γὰρ ἄρτιον εἶναι καὶ περιττόν, τὸν δ' ἀριθμὸν ἐκ τοῦ ἑνός, ἀριθμοὺς δέ, καθάπερ εἴρηται, τὸν ὅλον οὐρανόν.* It was in accord with this view that things are 'numbers', that 'numbers' are generated from 'the unit', and that the 'unit' itself is the Even-Odd, the first union of *ἄπειρον* and *πέρας*, that the Pythagoreans studied arithmetic by means of geometrical patterns, exhibiting e.g. the law of formation of the series of 'second powers' of integers (4, 9, 16 . . .) from the addition of the successive odd integers (1 + 3, 1 + 3 + 5, 1 + 3 + 5 + 7 . . .) diagrammatically, producing successive 'square' figures by putting 'gnomons' round each square to form the next, and the like. The thought underlying this doctrine is clearly that geometrical properties of figures are a visible expression of the relations and properties of the numbers which the 'figures' represent.

Now the triangles which Timaeus is about to take as *ἀρχαί* for his cosmology are determinate patterns or figures. They are the determination of something by a definite numerical law. To get behind these *ἀρχαί*

would just be to replace a triangular pattern by the numerical formula which it expresses, and again to go behind that to the law of the formation of the number-series itself. Well then, of what numbers may we regard triangles as the expression? Obviously a triangle may be regarded as expressing any set of numbers which completely determine it. There can be, indeed, more than one such set of numbers which determine the same triangle. A plane triangle has six 'elements', the three sides and the three angles, and it can be determined completely (except in the so-called 'ambiguous' case, which need not detain us) if you know three out of the six, on the condition that one at least of your three numbers represents the length of a side of the triangle. Now we cannot credit the Pythagoreans of the fifth century with knowing how to represent the angles of a triangle by numbers. That presupposes some method of estimating the length of a circular arc, or rather its ratio to the whole circumference, such as e. g. the division of the circle into degrees, and there is no trace in Greek literature of any knowledge of such a division until Alexandrian times. On the other hand, a triangle is absolutely determined if you have the three numbers which represent the lengths of its sides, and it is quite certain that this—it is proved in Euclid as prop. i. 8—was well known to the Pythagoreans. They knew, for example, that if the sides of a triangle are in the ratios 3 : 4 : 5 the triangle is a right-angled one. Proclus (*In Euclid. Element.* i, ed. Friedlein, p. 428) gives a general rule for solving the arithmetical problem, given an odd integer to find two other integers such that they form a right-angled triangle along with the given integer (i. e. such that if the given odd integer be a and the other two x and y, we shall have $a^2 + x^2 = y^2$), and says that the rule is ascribed to Pythagoras, a similar rule for the case where the given integer is even being ascribed to Plato. This means at least that the first rule comes from the Pythagoreans earlier than the Platonic Academy. I submit then that Timaeus means that to be completely scientific we ought to get behind our triangles to the triplets of *numbers* which represent the ratios of the lengths of the sides, and next to have a theory of the way in which the number-series of which these numbers are members is generated. What 'the friends of God' know is just the great Pythagorean science of sciences, *ἀριθμητική*. For our immediate purpose, the construction of the corpuscles, we may be content to confine ourselves to geometry and to take two spatial patterns as ultimate, but Timaeus means that geometry itself is applied *ἀριθμητική* and that what we call the properties of a triangle really depend on the properties of a group of three numbers. For the tone of the reference to 'God's friends' in such a connexion cf. *Philebus* 16 c 5 ff., where with an allusion to Pythagoras and his arithmetic (which is called a gift brought by a Prometheus from heaven) the Pythagoreans are spoken of half-seriously, half-playfully, as *κρείττονες ἡμῶν καὶ ἐγγυτέρω θεῶν οἰκοῦντες*.

But why is the allusion made in this mysterious fashion? It would be irrelevant to rake up the tales of late writers about the secrecy with which the Pythagoreans concealed their doctrines from the outside world. It is very doubtful whether there is any foundation in fact for these stories, which are only related by late writers and may have been invented

in large part to make it easier to father forged documents on early Pythagoreans. Even if there were foundation for the stories, they would not explain the reticence of Timaeus on this particular point. All through the dialogue he has spoken as a philosopher to brother philosophers; he has affected no kind of concealment. We should expect him, if he practised reserve at all, to show it in his language about God, the central thing of his whole philosophy. But there is not the slightest trace of any keeping back of his whole mind there. The reason for his enigmatic way of speaking on the particular point now under discussion is therefore presumably a more special one, and I do not think it hard to guess what it is.

If we suppose that the ἀρχαί of which Timaeus speaks are the numbers which correspond to the sides of his triangles, and ask ourselves what numbers these are, we come at once on something very striking. He has already told us that one of his two triangles is the isosceles right-angled. If we take as our unit the length of one of the two equal sides of this triangle, it follows from the Pythagorean theorem itself that the triplet of 'numbers' completely determining the triangle is 1, 1, $\sqrt{2}$. We shall learn directly that the particular scalene right-angled triangle he proposes to use is that in which the hypotenuse is double the length of the shorter side. It follows, again from the Pythagorean theorem, that the triplet of numbers determining this triangle, if we take the shorter side as our unit, is 1, $\sqrt{3}$, 2. Thus what we call an 'irrational number' is involved in both cases. The λόγος of each of the equal sides of the first triangle to the hypotenuse is $1 : \sqrt{2}$, the λόγος, in the other triangle, of the shorter side to the longer is $1 : \sqrt{3}$ and that of the longer side to the hypotenuse is $\sqrt{3} : 2$. These are not λόγοι of an integer to an integer. Such magnitudes as $\sqrt{2}$ and $\sqrt{3}$ are, in fact, not ἀριθμοί at all in the Pythagorean sense since they cannot be got by the 'repetition of the unit'. That there should be 'incommensurable' magnitudes, like the side and diagonal of a square, was really fatal to the correspondence between geometry and arithmetic so long as no 'numbers' were recognized other than the integers. The Pythagoreans could not help being aware of the very awkward fact. As Bt. has said, the discovery that 'the side and diagonal' have no common measure would be forced upon them by the Pythagorean theorem itself, and that they had made the discovery early is shown by the fact that we have the authority of Dercylidas and Adrastus for crediting them with the invention of the series of πλευρικοί and διαμετρικοὶ ἀριθμοί, the object of which is to find a rational fraction as nearly equal to $\sqrt{2}$ as possible. Presumably they were aware of other such cases. They can hardly have failed to discover the irrationality of $\sqrt{3}$ in connexion with the second of Timaeus's triangles, a figure which, as we shall see, had attracted their attention. Similarly there cannot be much doubt that the 'golden section' (Euclid ii. 11) is a Pythagorean construction, especially when we remember that it is a step to the inscription of the pentagon in the circle, and also that the sides of the pentalpha or star-pentagon, notoriously a Pythagorean emblem, cut one

another in this ratio, and the 'golden section' is the construction of another 'irrational' length.[1] But we may imagine that the Pythagoreans were not very ready to talk about a discovery which seemed to ruin the whole doctrine that 'things are numbers'. The quaint legends which connect the expulsion of Hippasus from the Order with his publication either of the incommensurability of the side and diagonal or of the inscription of the dodecahedron seem to suggest that his real offence lay just in this wanton exposure of what Bt. has called the 'skeleton in the cupboard'. The discovery of irrational magnitudes was in fact the turning-point in the history of early Greek mathematics. It left only two courses open to consistent thinkers. One was to cut geometry loose from arithmetic and give it independent treatment. Then you could say that there are 'irrational' lengths or 'areas' or 'volumes' but no irrational numbers because μεγέθη, geometrical magnitudes, are one kind of magnitude, ποσὸν συνεχές, *continuous* magnitude, but numbers quite another kind, διωρισμένον ποσόν, 'discrete' magnitude (i.e. magnitudes made up of equal indivisible units). In this way you can keep to the old view that there are no numbers except the natural integers at the cost of destroying the old parallelism between arithmetic and geometry. This was the plan adopted by Eudoxus and his associates in the Academy who recast elementary geometry and arithmetic into the form in which it passed to Euclid. This is why in Euclid's *Elements* in Bks. I–VI you get plane geometry together with the theory of proportion (Bk. V), which is required for the study of similar figures, reconstructed by Eudoxus in a way which makes proportion and ratio independent of number, with the consequence that no assumption is made anywhere in these books about the commensurability or incommensurability of the magnitudes studied. Arithmetic then follows in Bks. VII–IX, and the study of incommensurables, treated all through as lengths or areas, in Bk. X. It is also the line followed by Aristotle, an enthusiastic admirer of Eudoxus, who formally draws the distinction between μεγέθη and ἀριθμοί as indicated above in the discussion of the category of ποσόν in the *Categories*, and makes it a capital point of his difficult argument against the Pythagoreans and the Academy in *Metaphysics* M-N that there is no kind of number except μοναδικὸς ἀριθμός, i.e. the integer-series. Plato took a different line. In the *Republic* he had made Socrates adopt the Pythagorean order of the sciences in which arithmetic comes before geometry, and we find the same order retained at the very end of his life in *Epinomis* 990 c—991 b. This involves the view that the 'surds' really are a class of numbers, and that the old restriction of the name ἀριθμός to the integers must be abandoned. Accordingly we find that the Athenian speaker of the *Epinomis* makes a great point of saying that 'what is very absurdly called γεωμετρία—mensuration of land—is really the study of one class of numbers and what people call

[1] For if $a+b$ be the whole line thus divided into the parts a, b, we have, by definition of the 'golden' section, $a:b :: b:a+b$, and this gives the equation $b^2-ab-a^2=0$, with the solution $b=a\left(\frac{1\pm\sqrt{5}}{2}\right)$, where, if b is the greater segment, we, of course, take the upper sign before the square root.

στερεομετρία—measurement of solids—is the study of another class. It is worth while to quote the actual words of the passage. The speaker, who has been dwelling on the importance of a study of 'the generation of the odd and even', i. e. the arithmetic of the integers, goes on at 990 d 1 *ταῦτα δὲ μαθόντι τούτοις ἐφεξῆς ἐστιν ὃ καλοῦσι μὲν σφόδρα γελοῖον ὄνομα γεωμετρίαν, τῶν οὐκ ὄντων δὲ ὁμοίων ἀλλήλοις φύσει ἀριθμῶν πρὸς τὴν τῶν ἐπιπέδων μοῖραν γεγονυῖά ἐστιν διαφανής*, 'when a man has learned all this, next in order comes what is called ludicrously enough geometry (land-surveying), but it really is manifestly an assimilation of *numbers* which are not naturally similar to one another by having regard to area-numbers'. (*ἐπιπέδων* is clearly, I think, here an adjective and means *ἐπιπέδων ἀριθμῶν*, numbers which are the product of two factors—the reference being to 'square' numbers.) The meaning is this. Two such 'numbers' as $\sqrt{2}$ and $\sqrt{3}$ are not 'naturally similar', they have no 'common measure', so that you can't even say from an examination of them as they stand whether they are equal, and if they are not, which is the greater. But multiply each by itself; then $\sqrt{2} \times \sqrt{2} = 2$ and $\sqrt{3} \times \sqrt{3} = 3$, and 2 and 3 have a 'common measure' and can be compared. So you lay it down that if $a > b$ then $\sqrt{a} > \sqrt{b}$ and thus effect a comparison between two things which are not *φύσει* similar. The Athenian proceeds (I give the words as Bt. prints them from the best MSS. but with considerable doubt as to the precise text), *μετὰ δὲ ταύτην τοὺς τρὶς ηὐξημένους καὶ τῇ στερεᾷ φύσει ὁμοίους· τοὺς δ' ἀνομοίους αὖ γεγονότας ἑτέρᾳ τέχνῃ ὁμοιοῖ, ταύτῃ ἣν δὴ στερεομετρίαν ἐκάλεσαν οἱ προστυχεῖς αὐτῇ γεγονότες*. I am not sure that this can be translated without some small correction, but the general sense is clearly, 'and after this science we must study numbers of the third increase, which are like solids; and here again those which are dissimilar are assimilated by a second science —that which those who have hit upon it named stereometry'. It is thus quite clear that the *Epinomis* regards both quadratic and cubic 'surds' as numbers. I suggest then that the real reason for the obscure way in which Timaeus speaks is that he could not be more precise without raising the question whether $\sqrt{2}$ and $\sqrt{3}$ are numbers, and that, as a Pythagorean, he wishes to keep this difficulty in the background.

If this is the correct explanation of the passage Timaeus is only talking as a real fifth-century Pythagorean, aware that he was approaching the dangerous topic of incommensurables, might be expected to speak. There is no plain allusion to Plato's own doctrine about the '*ἀριθμοί* which are the *εἴδη*'. For this reason I have abstained from taking into account here Aristotle's polemic against the doctrine he ascribes to Plato that the 'ideal' numbers are *ἀσύμβλητοι*, whether this means 'not addible' (R.P. 328 f.) or 'not comparable', 'not commensurable' with one another. Amid all the many uncertainties which beset the interpretation of this Platonic doctrine, one thing appears to me clear, that the Platonic 'numbers' against which the polemics of the *Metaphysics* are directed are, as Aristotle habitually assumes, the integers which constitute the *δεκάς*.[1] As I

[1] If the numbers which are *εἴδη* are those of the 'decad' they *are* commensurable. But I am not *sure* that the description of them as *ἀσύμβλητοι* is more than an inference

feel convinced that Timaeus is not speaking of them at all but of the quadratic 'surds' $\sqrt{2}$ and $\sqrt{3}$, I do not think a discussion of the meaning of these Aristotelian statements and their fairness or unfairness in any way relevant to the interpretation of our dialogue. I feel sure that the *εἴδη–ἀριθμοί* are no more mentioned in the *Timaeus* than in any other Platonic dialogue.

53 e 2. αὐτῶν ἅττα. Timaeus refuses to admit the full innovation of Empedocles who had proposed to substitute four irreducible 'roots' of everything for the old conception of the one primary 'stuff', apparently in consequence of Parmenides' criticism of the earlier view. He admits that 'earth' cannot be converted into anything else, but still clings to the view that the other three 'roots' can be transformed into each other. Thus the scheme of cosmology he proposes is a sort of compromise or half-way house between Empedocles and the full-blown 'transformationism' of the earlier Ionians. No doubt it would be easier to believe that we actually see water converted into air, and air into fire, than to believe that any of these can be converted into rock or stone, or rock and stone into them. The convertibility of earth with the rest, suggested perhaps by the alluvial deposits brought down by rivers, would comparatively easily be seen to have been inferred from erroneous observations. It is because of this irreducibility of 'earth' that Timaeus needs *two* primary triangles. The aesthetic feeling of Timaeus is that which we should expect in a mathematician. To him the proposition that the 'roots' are the most beautiful of visible bodies (53 e 5) suggests at once that we must look for the shapes of their particles among the 'regular solids', i. e. those of which each has equal and similar plane figures for its faces.

53 e 7. τὰ διαφέροντα κάλλει . . . γένη. The editors in general are clearly right in taking this to mean 'the four *specially* beautiful bodies', i. e. the regular solids which are to be the corpuscles of the roots. Fraccaroli wants to render 'four kinds of bodies *differing* in beauty, taking *συναρμόσασθαι* to mean to 'co-ordinate' these four bodies (not to 'construct' them). He is manifestly wrong on the first point as the definite article *τά* is enough to show, and the fact that T. proceeds at once to a 'construction' makes it almost equally certain that he is wrong on the second point also. Any reference to a supposed difference in *κάλλος* between the regular solids, of which we never hear again, would be irrelevant.

54 a 1–b 2. τοῖν δὴ δυοῖν τριγώνοιν . . . τὰ ἄθλα. We know that one of our two elementary triangles is to be the isosceles right-angled. We have next to decide which of the forms of scalene right-angled triangle is to be the other. The word *πρόμηκες* means 'having one side longer than the other'. It is applied primarily to rectangles with unequal sides (and consequently to numbers which are the products of two unequal factors), and thus means 'oblong'. It can be applied exceptionally here

of Aristotle's own drawing. He knew that according to Plato the integer-series is not generated by successive additions of 1, the 'unit', to itself, and he may have inferred, on his own account, that unless numbers are repetitions of a 'unit' they cannot be said to be one and all 'measurable' by the 'unit'.

to a scalene right-angled triangle because such a figure is half of an 'oblong' of which the hypotenuse of the triangle is the diagonal. T. selects as the 'fairest' of them all that from a pair of which 'the equilateral triangle is composed as a third figure' (ἐκ τρίτου), i. e. the right-angled triangle got by dropping a perpendicular from one vertex of an equilateral triangle on the opposite side. The perpendicular bisects the base (Euclid i. 26), so that if the length of a side of the original triangle is $2a$, that of the shorter side of the new triangle thus obtained is a, and that of its hypotenuse is $2a$. It follows from the Pythagorean theorem that the length of the remaining side is $\sqrt{3}a$, so that the ratios of the three lengths are $1 : \sqrt{3} : 2$. One of the angles is 60°, being an angle of the equilateral triangle, another, being by construction a right angle, is 90°, and the third is therefore (Euclid i. 32) 30°. The angles are thus in the ratios of the three first integers 1, 2, 3. (Thus what Timaeus is doing in effect is finding the fundamental trigonometrical ratios sin and cos for an angle of 60° and one of 30°.) Though he personally chooses to regard this as the most beautiful of scalene and right-angled triangles (τιθέμεθα δ' οὖν, a 5–6), he is willing to listen to any one who can point out one more suitable for cosmological purposes. *Why* he regards this particular triangle as so beautiful he does not explain, but evidently expects the audience to understand. The reason, in fact, is that the ratio of the two acute angles is 2 : 1, the simplest of all ratios after the ratio of equality (1 : 1) which obtains between the acute angles of the isosceles right-angled, and again the ratios of the acute angles to the right angle of the triangle are 1 : 3 and 2 : 3, the simplest of all ratios except 2 : 1 and 1 : 1.

From the brevity and apparent arbitrariness of the explanation we might at once infer that we are dealing with something which would be expected from Timaeus as a matter of course, in other words, that the two special triangles in question were known to play a special part in Pythagorean theory. That this is actually so we know from an important fragment from the work of Plato's nephew and successor at the Academy, Speusippus, on 'Pythagorean numbers according to the doctrine of Philolaus'. The fragment, preserved to us in the Neo-Pythagorean *Theologumena Arithmetica*, is most conveniently consulted either in Lang's *Speusippi Fragmenta* (Bonn 1911), where it appears as Fr. 4, or in *Fr. d. Vors.*[8] i. 303–5. The relevant part of the passage runs as follows; 'The first triangle is the equilateral which has in a sense (πως) only one side and one angle. I say one, because they are equal, for the equal is always undivided (ἄσχιστον) and unitary (ἑνοειδές). Second is the half-square (τὸ ἡμιτετράγωνον), for, as it has only one difference (παραλλαγήν) of sides and angles, it may be discerned in the number 2 (ἐν δυάδι ὁρᾶται). Third is the half of the equilateral or half-triangle (τὸ ἡμιτρίγωνον), for it is unequal in every detail (πάντως γὰρ ἄνισον καθ' ἕκαστον), and the all in its case (τὸ πᾶν [τι] αὐτοῦ) is three. So in the solid figures you will find a similar progression up to four (εὑρίσκοις ἂν ἄχρι τῶν τεττάρων προίον τὸ τοιοῦτο). . . . The first pyramid [i.e. the regular tetrahedron] has in a sense (πως) one edge (γραμμή) and one angle in equality, like a number 1. The second has the angles at the

base enclosed by three planes and that at the apex by four, and in this way resembles 2. [This is a pyramid on a square base.] The third stands on the half-square and besides the point of difference we have seen in its plane base the half-square has as another that of the angle at the apex. So it may be likened to 3. . . . In the same way the fourth, which is constructed on the half-triangle as a base, is like 4.' From the statement of the *Theologumena Arithmetica* that the work of Speusippus was based on the teaching of Philolaus we may reasonably infer that Timaeus is largely reproducing that philosopher in this part of his discourse. There are also traces of him in the physiological sections of the dialogue. Hence I regard it as reasonably established that the peculiar combination of mathematical physics with Empedoclean biology which pervades the dialogue is meant by Plato as an historically correct picture of the science of Italy and Sicily in the last third of the fifth century. I lay no stress on [Philolaus] Fr. 12 (R. P. 79, *Fr. d. Vors.*[3] i. 314) *καὶ τὰ μὲν τᾶς σφαίρας σώματα πέντε ἐντί*, κτλ., since it may be itself an echo of our dialogue. Note that T. does not *expressly* mention the 'inscription' of the dodecahedron, though it is implied. The names *ἡμιτετράγωνον* and *ἡμιτρίγωνον* are employed as technicalities for the two triangles in question in *Timaeus Locrus* 98 a–d, and meet us again in Proclus's commentary on Euclid I. At p. 222. 7 (ed. Friedlein) the isosceles triangle which has the vertical angle double of either of the equal base angles—i.e. the right-angled isosceles—is spoken of as the *ἡμιτετράγωνον*; at 383 both the *ἡμιτετράγωνον* and the *ἡμιτρίγωνον* are mentioned, and it is noted that each of the acute angles of the former is half a right angle, one of those of the latter two-thirds and the other one-third of a right angle. 'I make these remarks', says Proclus, 'as preparatory to the exposition of the *Timaeus* (*οὐ παρέργως ἀλλὰ ὡς προπαρασκευάζοντα ἡμᾶς πρὸς τὴν τοῦ Τιμαίου διδασκαλίαν*, op. cit., ed. Friedlein 384. 2).[1]

It thus appears from Speusippus that the two triangles employed by Timaeus received special notice from the Pythagoreans and were admired more than any others except the equilateral triangle itself, because they are, in a sense, composed of the fewest elements. Given the side of an equilateral triangle and the knowledge that it is to be equilateral, the figure is completely determined. It has, in a sense, only one side and one angle. Thus it stands nearest of all triangles to complete unity. The isosceles right-angled has one inequality of sides and one of angles and is like the number 2. The 'half-triangle', the particular scalene right-angled triangle selected by Timaeus, is like 3 because it has three unequal sides and three unequal angles. But it is less irregular than all other scalene triangles, as the remarks of Proclus suggest, because of the very simple ratios between its angles. Since the immediate use Timaeus makes of the 'half-square' and 'half-triangle' is to construct a whole square out of the one and a whole equilateral triangle out of the other, he gets into his construction all three of the triangles specially distinguished by the Pythagoreans. So far, it is clear, he is merely repeating the doctrine

[1] The point that the angles of the *ἡμίτριγωνον* have these proportions is also carefully noted at *Timaeus Locrus* 98 a. Obviously it was the tradition that this is the special 'beauty' of which Timaeus speaks in connexion with the figure.

current in the school. Whether any one had further made a cosmological use of these triangles as the basis of the corpuscles of the 'roots', or whether this is purely original on the part of Timaeus, does not appear. At any rate the development is in the natural line of Pythagorean thought. If we knew more of Pythagoreanism than we do, we might find that there were really attempts at a corpuscular physics of this kind in the fifth century, though the whole theory could not well have been worked out before the discovery of the construction of the octahedron and icosahedron by Theaetetus.

54 b 2. κεῖται φίλια τὰ ἆθλα. AF have the accentuation *φιλία* and this was introduced into the text by Bekker who has been followed by a number of later editors, St., Hermann, the Zürich editors, Martin, and adopted by the recent Italian translator Fraccaroli. A.-H., like Bt., retains the *φίλια* of the printed text before Bekker. In matters of this kind the accentuation of the MSS. has no authority, as it only indicates the opinion of a scribe or a *diorthotes*. I cannot think A.'s reading deserves the acceptance it has won. To make T.'s *φιλία* for any man *depend* on the man's refuting him (*κεῖται φιλία*) is not really sound sense, since it is implied that to win T.'s *φιλία* you *must* controvert his theory! The real meaning is that 'the prize will be awarded' to the victor 'without a dispute'. Philo echoes the words, but with *φιλία* for *φίλια* in a different sense (*Vit. Abrahami* 25), where God is represented as saying *τὰ δὲ ἆθλα τοῖς μὲν ἐμὲ δι' ἐμὲ τιμῶσι κεῖται φιλία, τοῖς δὲ διὰ τὰς χρείας φιλία μὲν οὔ, τὸ δὲ μὴ ἀλλοτρίους νομίζεσθαι.* The sense here requires the accentuation *φιλία*. If Philo supposed Plato's words to be meant in the same way he misunderstood his original.

54 b 3. τό τε τοῦ πυρός. One should not supply a substantive. This is to distort the view of nature taken throughout the dialogue by obtruding the notion of 'substrate' on it. *τὸ τοῦ πυρός* is a mere periphrasis for *πῦρ* and should be rendered simply 'fire'.

54 b 4–5. τριπλῆν κατὰ δύναμιν. *δύναμις* has here its commonest mathematical meaning, the same which it bears e. g. all through Euclid's Tenth Book, 'second power'. Hence *τριπλῆν κατὰ δύναμιν* means 'triple when raised to the second power'. The longer side when 'squared' is three times the shorter side (when squared also). As we should say, the ratio of the two sides is $\sqrt{3} : 1$. But Timaeus is careful not to say anything which amounts to recognizing this ratio as a *λόγος ἀριθμοῦ πρὸς ἀριθμόν*. He speaks only of the 'squares', not of their 'square roots', as having a ratio.

54 b 6. τὸ δὴ πρόσθεν ἀσαφῶς ῥηθέν. A reference to the words *ἅττα αὐτῶν*, 53 e 2. It is not *σαφές* merely to say that 'some' of the 'roots' can be resolved into one another. We need to know which are meant. The incommutability of 'earth' with the rest is to be explained by the theory that its molecule is the cube, whose faces are squares, and the square can be constructed only out of *ἡμιτετράγωνα*, not from *ἡμιτρίγωνα*, while the equilateral triangle, the face of the other three molecules, can only be built up with *ἡμιτρίγωνα*. It is assumed that the faces of the molecules can only be physically broken up along the lines of cleavage which are sides of the 'elementary' triangles. The two 'elementary'

triangles are physically the ultimates of the theory, and therefore indivisibles, though they have finite areas, are not 'infinitesimals'.

54 d 1–4. **εἷς ἀριθμὸς ἑνὸς ὄγκου . . . ἐξ ὅσων . . . ἀριθμῶν.** Timaeus thus gives a definite interpretation to the Pythagorean thought that things are 'numbers' or 'made of numbers', or, as Aristotle puts it, that number is the *stuff* of things (*Met.* A. 986ª 15 *φαίνονται δὴ καὶ οὗτοι τὸν ἀριθμὸν νομίζοντες ἀρχὴν εἶναι καὶ ὡς ὕλην τοῖς οὖσι κτλ.*). The 'numbers' in question are identified in the last resort with the number of plane faces in the molecules of their 'roots'; it is out of these numbers that 'things' are constructed. Compare and contrast what we are told of Eurytus of Crotona, a disciple of Philolaus (Iamblichus *Vit. Pyth.* 148), and therefore roughly a contemporary of Socrates, by Theophrastus and [Alexander] on Aristotle *Met.* N. 1092ᵇ 8 (*Fr. d. Vors.*³ i. 320–1). Eurytus tried to determine the constitutive numbers of things like men and horses directly by arranging counters in the pattern of a man or a horse and counting the counters. What Timaeus has in view is something more scientific, something like an attempt to give the chemical formula for the constitution of a complex molecule in terms of the number of faces of its constituent simple atoms, or, pursuing the analysis one step further, in terms of the numbers of elementary triangles of which the faces are composed.

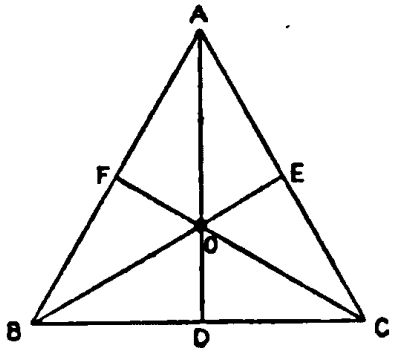
54 d 5. **τό τε πρῶτον εἶδος καὶ σμικρότατον.** This is the regular tetrahedron or 'pyramid' with four faces, each an equilateral triangle. It will be assigned as the molecule of fire. It is *τὸ πρῶτον* because four faces are the fewest which can enclose a rectilinear solid, and the triangles which constitute these faces are the simplest plane figures. As we should say, four points not all in the same plane are sufficient and necessary to determine a 'solid'. Hence 4 was called by the Pythagoreans the number of the solid. Speusippus Fr. 4 (*Fr. d. Vors.*³ i. 304. 16) *τὸ μὲν γὰρ ᾱ στιγμή, τὰ δὲ β̄ γραμμή, τὰ δὲ γ̄ τρίγωνον, τὰ δὲ δ̄ πυραμίς*; Aristot. *de Anima* A. 404ᵇ 17 ff. The tetrahedron is also *σμικρότατον*, either because it has the least volume of all the regular solids with an edge of the same length, or rather because it is the least in volume of the regular solids inscribed in one and the same sphere, or for both reasons at once.

54 d 6. **στοιχεῖον δ' αὐτοῦ.** *στοιχεῖον* is here used almost in the literal sense of 'letter of the alphabet'. The thought is that the regular solids are like syllables of nature's book, the elementary triangles are the letters by which they are spelt out.

54 d 6–7. **τὸ τὴν ὑποτείνουσαν . . . μήκει.** That is, the particular right-angled scalene triangle known to the Pythagoreans as the *ἡμιτρίγωνον*. We have already been told (54 b 4–5) what is the relation between its longer and shorter 'sides', or rather between the areas of the 'squares' on them. It is now added that the ratio of the hypotenuse to the shorter side is 2 : 1, so that we now know that the three sides are proportional to 2, $\sqrt{3}$, 1, respectively.

54 d 7–e 3. **σύνδυο . . . γέγονεν.** We are now told how to construct an equilateral triangle out of six such *ἡμιτρίγωνα* so arranged that they have a common vertex. As was already said, and as the name *ἡμιτρίγωνον* indicates, you can construct an equilateral triangle out of *two* such triangles, but Timaeus prefers to subdivide each of the two further

into three smaller triangles, each similar to the whole. This is done by drawing the three perpendiculars from each of the angles of the original equilateral triangle on the opposite side, as in the subjoined figure. The three perpendiculars meet at the point *O* and the six triangles which have a common vertex at *O* are all ἡμιτρίγωνα, as it is easy to prove. The reason for preferring to construct the equilateral triangle out of these six rather than simply of the two ἡμιτρίγωνα *ABD*, *ACD* is, as C. W. says, that the division is symmetrical with respect to *A*, *B*, *C*, and, one may add, that the determination of *O*, the common vertex of the six triangles, is geometrically and mechanically important. *O* is the centre both of the circle described about *ABC* (of which *OA*, *OB*, *OC* are radii), and of the circle inscribed in *ABC* and touched by its sides at *D*, *E*, *F* (the radii being *OD*, *OE*, *OF*); it is also, since *ABC* is equilateral, the 'centre of mean position' of the points *A*, *B*, *C*, and, if the triangle be supposed to have weight (being thought of as a very thin uniform lamina), its centre of gravity. Since there is no doubt that the substance of Book IV of Euclid's *Elements* is pre-Academic, all these



propositions must be supposed to be familiar to Timaeus, except that he would have no technical name for the 'centre of gravity'.

As for the directions given for the performance of this construction, the editors have been misled by Boeckh. κατὰ διάμετρον, d 8, does not mean, as they suppose, 'so that their hypotenuses coincide',[1] but 'diagonally' 'in a diagonal'. That is, you place a pair of triangles about *O* (say *AOF*, *COD*) so that their equal angles *AOF*, *COD* are vertically opposite and the pairs of sides *AO*, *OD*, *FO*, *OC* are each in one straight

[1] The blunder is made by Boeckh (*de Platonica corporis mundani fabrica*, *Kl. Schrift.* iii. 245), Stallbaum, Martin, A.-H., Apelt, one after the other, though Apelt sees that it *may* be a blunder. Apparently it originated with Windischmann, who published a German translation of the dialogue in 1804. Stallbaum, however, admits that the supposed use of the phrase κατὰ διάμετρον is singular. For the phrase cf. Aristotle *Ethic. Nic.* E. 1133ᵃ 6 ποιεῖ δὲ τὴν ἀντίδοσιν τὴν κατ' ἀναλογίαν ἡ κατὰ διάμετρον σύζευξις, the 'cross-conjunction', i.e. the multiplication of the 'extremes' and that of the 'means' of a proportion. Ar. is imagining the figure

and AΔ, BΓ are the διάμετροι; *De Caelo* A. 277ᵃ 23 ἐπεὶ καὶ ἡ κύκλῳ ἔχει πως ἀντικείμενα τὰ κατὰ διάμετρον, *Hist. Animal.* B. 498ᵇ 5 αἱ δὲ κινήσεις τῶν ζῴων τῶν μὲν τετραπόδων καὶ πολυπόδων κατὰ διάμετρόν εἰσι καὶ ἑστᾶσιν οὕτως, et saepe. (I.e. when a quadruped walks, the front leg on one side and the back leg on the other move together. If this were not so, quadrupeds would 'hop' in a helpless fashion.) It ought to have been unthinkable that Timaeus should propose to make his equilateral triangle out of trapezia.

line. This arrangement is said to be *κατὰ διάμετρον*, because if you complete the quadrilateral *ACDF* by drawing *DF*, the two straight lines *AD*, *FC* obtained by the construction are the *διάμετροι*, 'diagonals' of the quadrilateral. Boeckh and the others suppose that the triangle *AOE* is that which is *κατὰ διάμετρον* to *AOF*, i.e. they think the *διάμετρος* meant is *AO*, that of the figure *AEOF*. The real meaning of the phrase is plain from e.g. Euclid *Element.* ii, def. 2 *παντὸς δὲ παραλληλογράμμου χωρίου τῶν περὶ τὴν διάμετρον αὐτοῦ παραλληλογράμμων ἓν ὁποιονοῦν σὺν τοῖς δυσὶ παραπληρώμασι γνώμων καλεῖται*, vi. 24 *παντὸς παραλληλογράμμου τὰ περὶ τὴν διάμετρον παραλληλόγραμμα ὅμοιά ἐστι τῷ τε ὅλῳ καὶ ἀλλήλοις*. It is part of the same terminology that the numerators of the fractions used as approximations to $\sqrt{2}$ are called *διάμετροι* and the denominators *πλευραί*, because if the denominator gives the length of the side of an isosceles right-angled triangle, the numerator gives approximately the length of the hypotenuse (the diagonal of the square of which the triangle is one half).

54 e 3—55 a 2. τρίγωνα . . . γεγονυῖαν. We are to take four equilateral triangles and make them meet by threes at a common angular point, so that there are in all four such points where three angular points of equilateral triangles coincide. The three triangles, in every case, are in three different planes, as is indicated by the words *μίαν στερεὰν γωνίαν ποιεῖ*. As the angle of the equilateral triangle is two-thirds of a right angle (60°), each of these solid angles will contain $3 \times \frac{2}{3}$ right angles, or 180°. But, instead of saying this in so many words, T. says that the solid angle so formed is 'that which comes next after (*ἐφεξῆς*) the most obtuse of plane angles', i.e. it is the least angle which is not less than 180°, another way of saying that it is itself an angle of 180°. A.-H. and Apelt should not have made the unfortunate remark that the 'obtusest of plane angles' means an angle of 179°. This is to impute to Plato the division of the circle into 360°, a device which seems only to have reached the Greek world from Babylon in Hellenistic times, and to credit him with the blunder of supposing that there is a 'greatest' obtuse angle, i.e. that angular magnitude is discontinuous.[1]

55 a 2–4. τοιούτων δὲ . . . συνίσταται. Our construction thus gives us a regular solid with four similar and equal faces, all equilateral triangles, and four solid angles, each made by the meeting of three angles of 60° lying in three different planes. This is the regular tetrahedron or, as Euclid calls it, pyramid. (His definition of *πυραμίς* at *Element.* xi. def. 12 covers all solid figures on a plane base and with a single vertex, but the only 'pyramids' with which he actually deals in xi–xiii are regular tetrahedra.) It is the *πρῶτον εἶδος στερεόν*, as already explained on 54 d 5, because it is the one with the fewest faces and angular points (the figure determined by the minimum of points).

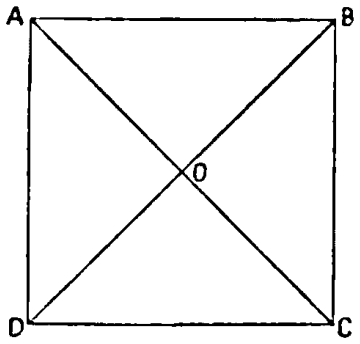
55 a 3. ὅλου περιφεροῦς διανεμητικόν. The *περιφερές* does not mean, as A.-H. supposes, the surface of the pyramid. As this is composed of four equilateral triangles, and every side of each of these

[1] T.'s words mean, in fact, 'the lower limit of the positive values of an angle θ such that θ is not less than π', and this limit is π.

triangles is also a side of a second, it is superfluous to say that the area of each triangle is one-fourth of that of the whole four. And *περιφερές* does not mean 'surface'. It means, as always, 'round'. According to context a *περιφέρεια* means either the 'round' circumference of a circle, or the 'round' surface of a sphere. Here it, of course, means the latter. Thus the translation is 'dividing the whole surface (of the sphere) into four equal parts', as M. properly renders. The reference is to the 'inscription' of the tetrahedron, and it meant that the tetrahedron divides the surface of the sphere into four equal and similar regions. This is the only express allusion Timaeus makes to the 'inscriptions' of the regular solids, and it is made in connexion with an inscription expressly ascribed by tradition to the Pythagoreans.

55 a 4–8. δεύτερον . . . τέλος. The next regular solid has also equilateral triangles for its faces, but there are eight of them and each of its solid angles is formed by the meeting of four plane angles of 60°. This is the octahedron (Euclid *Element.* xi, def. 26 *ὀκτάεδρόν ἐστι σχῆμα στερεὸν ὑπὸ ὀκτὼ τριγώνων ἴσων καὶ ἰσοπλεύρων περιεχόμενον*). In a 6 *ἐπιπέδων* is gen. pl. *feminine* of the adjective *ἐπίπεδος*, agreeing with *γωνιῶν*, 'understood', not a substantive. The mere 'meeting of four planes' would not constitute the angle required; they might have a straight line as their common section. The number of the angles of the figure is, of course, six.

55 a 8–b 3. τὸ δὲ τρίτον . . . γέγονεν. The third is formed from 120 'letters' of nature's alphabet. As the 'letters' are the elementary triangles and we are still dealing with the words which can be spelt out with the *ἡμιτρίγωνον* alone, this means that it has 120/6 or 20 faces, all equilateral triangles. It has twelve solid angles each 'enclosed by' five plane angles of 60°. Since 'spherical trigonometry' did not exist in the fifth century, it seems hardly likely that *ἐπιπέδων* in b 1 agrees with *τριγώνων*; it would be unnecessary to specify that by *τρίγωνον* T. means a *plane* triangle, when no one ever meant anything different by the word. Hence I take it that *ἐπιπέδων* still means *ἐπιπέδων γωνιῶν* and that *τριγώνων* is a dependent genitive, 'five plane angles which belong to equilateral triangles'. The figure is the regular icosahedron (*σχῆμα στερεὸν ὑπὸ εἴκοσι τριγώνων ἴσων καὶ ἰσοπλεύρων περιεχόμενον*, Euclid *Element.* xi, def. 27).



55 b 3–c 4. καὶ τὸ μὲν ἕτερον . . . βάσεις ἔχον. The *ἡμιτρίγωνον* has now produced all the offspring it can; we turn to the other *στοιχεῖον*, the 'half-square'. If four right-angled isosceles triangles are placed so that

they have a common vertex, they make a square. The common vertex is the point where the diagonals cross, the centre of the circle described about the square, and centre of mean position of its angular points. Here again we see that we have two pairs of 'half-squares' *AOB* and *DOC*, and again *AOD* and *COB* placed *κατὰ διάμετρον*, so that Timaeus is going to work in this second case on the same lines as in the first. From six such square faces, meeting three by three to form solid angles, of which there will be eight in all, we get the cube. The expression of c 1–2 *τρεῖς ἐπιπέδους ὀρθάς* (sc. *γωνίας*) bears out the view taken of the grammar of b 1–2.

55 c 4–6. *ἔτι δὲ κτλ.* There is still a fifth 'combination', i.e. a fifth regular solid, but it is not the molecule of anything, nor can its face be built up by the method T. is using. It was used for a different purpose. This fifth figure, the dodecahedron, has twelve faces, each of which is a regular pentagon (Euclid *Element.* xi, def. 28 *σχῆμα στερεὸν ὑπὸ δώδεκα πενταγώνων ἴσων καὶ ἰσοπλεύρων καὶ ἰσογωνίων περιεχόμενον*). Timaeus does not describe its construction. (Is this just a touch of Pythagorean 'reserve'?)[1] As he needs only four solids for the corpuscles of his 'roots', he has to find a different use for the fifth. He says God used it 'for the whole, embellishing it with designs'. The correct explanation of the remark is indicated in *Timaeus Locrus* 98 e *τὸ δὲ δωδεκάεδρον εἰκόνα τοῦ παντὸς ἐστάσατο, ἔγγιστα σφαίρας ἰόν.* Of the five solids inscribed in one and the same sphere the dodecahedron has the maximum volume and comes 'nearest to' coinciding with the sphere, as well as looking most like it in shape. So the *Phaedo* (110 b 6) compares the spherical earth with *δωδεκάσκυτοι σφαῖραι*, balls made by sewing twelve pieces of leather together. The pieces of leather would be pentagonal, and, if leather were inelastic, the ball would be a dodecahedron; owing to the elasticity of the leather it can be inflated until it is sensibly spherical. Plutarch saw here an allusion to the twelve *ζῳδία* of the Zodiac. This is out of the question, as these constellations form a circular band, but the twelve angular points of the dodecahedron inscribed in a sphere do not lie on any such band. Plutarch seems to suppose that the angular points of a regular solid are all in the same plane! Presumably he confused the dodecahedron with a dodecagon in a circle. As Bt. has said, the real allusion is to the mapping out of the whole apparently spherical heavens into twelve pentagonal regions for the purpose of charting the constellations. T. means that the sky, being 'round like a ball', is near enough in shape to the dodecahedron for this kind of treatment. **διαζωγραφῶν**, 'broidering figures on it'. *ζῷα* is the regular word for the figures in a picture or a piece of tapestry or embroidery, no matter what they represent, just as *ζωγράφος* is the regular word for a 'painter', not merely for a painter of animals. The *ζῷα* meant are the 'constellations'; they include those which form the Zodiac, but include all the rest as well. (Cf. [Olympiodorus] *in Phaedon.* ed. Norvin, 199. 4 *πῶς δωδεκασκύτῳ σφαίρᾳ ἔοικεν; ἢ ὅτι μέχρι αὐτῆς πρόεισι τὸ δωδεκάεδρον, ᾧ διαζωγραφεῖ τὸ πᾶν ὁ Τίμαιος,*

[1] Perhaps not. His reason for silence may be that he does not know how to construct a pentagon by placing pairs of similar triangles *κατὰ διάμετρον*, a thing which, in fact, obviously cannot be done.

ὃν ἐκεῖ λέγεται τρόπον.) The passage suggests that the Pythagoreans were interested in the systematic task of mapping out the sky, a work which goes back, according to tradition, to Cleostratus of Tenedos in the sixth century, and led up to the making of the first scientific star-catalogues by the Alexandrian astronomers. It also suggests that, as Bt. has remarked, the interest taken by the Pythagoreans in the inscription of the regular solids was prompted by a desire to ascertain the volume and surface of the sphere by approximation. This would explain the special interest in the dodecahedron, the greatest in volume of the solids which can be 'inscribed'. (It is notable that Euclid xiii. 17 (the inscription of the dodecahedron) is at once followed by a proposition about the ratios of the edges of the solids in the sphere.) All the figures which have been constructed are purely geometrical. They must not be supposed to have any property corresponding to 'mass' or to 'impenetrability'. They are simply volumes bounded by faces of different numbers and shapes. Also the 'solids' are not made by the piling of triangular, square, or pentagonal laminae on one another, but by giving their faces an inclination to one another so that they form 'solid angles', 'angles in space'.

55 c 7–d 6. ἃ δή τις . . . δοξάσει. Timaeus pauses to reassert his own view already expressed at 31 a–b that there is only one κόσμος. It is very loose thinking to suppose that there can be an indefinite number (note the play on ἄπειρος in d 1), but the discovery that there are five regular solids and no more makes it a more reasonable question whether there might not be five κόσμοι. It is not quite clear what the precise connexion of thought is. Does the statement that the shape of our κόσμος is approximately that of the dodecahedron suggest that there might be four others, each approximately like one of the other regular solids in shape? If only we knew more about fifth-century Pythagoreanism we should probably find that there is an allusion to some division of opinion in the school itself which accounts for this sudden return to a question already disposed of. We know from the reports about Petron that some early Pythagoreans did hold that there is a finite plurality of κόσμοι, and it would not be surprising if the view that there are just five had been advocated by some one, though there is apparently no record of anything of the kind. At any rate, the reason for the section seems to be a desire to offer some apology for Pythagoreans who believed in a limited number of κόσμοι on the ground that, mistaken as they are, there is something to be said for such a view, and that, at least, they have the grace to be on the side of πέρας as against τὸ ἄπειρον.

55 d 3. μᾶλλον ἂν ταύτῃ στάς. στάς = 'stopping there', 'stopping at
5 fixe'. As AYW are together here against the πᾶς of F, στάς may perhaps be regarded as quite the better accredited reading of the two, and the word is confirmed by the fact that it fits in with the general idea of taking the side of πέρας, stopping short somewhere, as contrasted with going on indefinitely (τὸ εἰς ἄπειρον προιέναι). But it is not true to say that πᾶς would be senseless; it would mean 'any one', 'a man', '*on*'. And it is likely enough that the 'archetype' had both readings, one in the text and the other in the margin.

55 d 4–6. **τὸ μὲν οὖν . . . δοξάσει.** This does not mean that it is an open question on which any one may with equal reason take either side. T. has already given us what he regards as conclusive proof that there is only one *οὐρανός*. But the proof was based on the uniqueness of that of which the *οὐρανός* is a 'likeness', and therefore belonged to *ἐπιστήμη*. What is meant here is that, if 'metaphysics' is left out of the question, and you confine yourself to the 'likely story', i.e. to the attempt to construct physical hypotheses, it must be left open to a man who thinks he can 'save the appearances' by the assumption of more than one *οὐρανός* to try his hand. Thus we may perhaps infer that Plato admits that, but for considerations of the metaphysical order, physics need not be committed to the hypothesis of only one 'stellar system'.

55 d 5. **θεόν** F, **θεός** A, om. WY, a very good example of a case where F alone of our MS. authorities has kept the obviously correct text. Bekker, St., Martin, A.-H., the Zürich editors, all omit *θεός*, and Hermann brackets it. Yet its presence in the MSS. has to be accounted for. The *θεός* is the *οὐρανός* itself, which is a *εὐδαίμων θεός*. The *θεός* of A will be due to a 'corrector' who supposed the Creator to be meant. The correction may have been entered on the margin of the 'archetype'.

55 d 5–6. **ἄλλος . . . δοξάσει.** Some have seen a contemptuous reference to Democritus, but there is no contempt in the expression, merely the declining of an argument in which it has just been conceded that there is much to be said on both sides. There was nothing peculiar to Democritus in the belief in many *οὐρανοί*, which had been the prevailing one in all pre-Platonic science. And the *τοῦτον* with whom 'we will not dispute the point' is not a believer, like Democritus, in the 'innumerable worlds', but the man who suggests that there are just five or some other definite number. T. has already dismissed those who believe in 'innumerable' *οὐρανοί* as *ἄπειροι ὢν ἔμπειρον χρεὼν εἶναι*. It seems to me clear that it is a divergent opinion within his own school which T. is declining to refute. We might think of Petron and his equilateral triangle with sixty *κόσμοι* in each side and three extra ones at the angular points (Plutarch *de defectu oracul.* 422 b, *Fr. d. Vors.*[8] i. 35). But Plutarch says that he knew Petron's views from a reference to them by Hippys of Rhegium, and apparently he took this reference itself at second hand from Phanias of Eresus, a Peripatetic of the first generation. Hippys *seems* to be the same person as the heretic and schismatic Hippasus, and Hippasus *seems* from all the accounts of him (see them collected at *Fr. d. Vors.*[8] i. 36–8) to be a figure of the middle of the fifth century. Petron, in that case, is presumably earlier, while the tone of our passage suggests that it refers to views which are still 'actual' at the time when Timaeus is supposed to be speaking.

55 d 7–e 7. **τὰ δὲ γεγονότα . . . βέβηκεν.** We have now to assign to each 'root' one of the four geometrical figures left on our hands as its particle. We may begin by assuming, as the probable account, that the particles of earth, the most inert of bodies and that which is most 'plastic' (i.e. retains most readily the figure once given to it), are cubes, as the cube has the most stable base (viz. a square).

55 e 2. **πλαστικωτάτη.** We might be inclined to say that water is

more 'plastic' than earth of any kind and air more so than water. But T. means that it is easier to 'work in' clay and the like, because the clay, unlike air or water, keeps the shape into which you have worked it. 'Viscous' is about the meaning. The viscosity is thus directly connected with the 'inertness', 'sluggishness', just mentioned, and the ultimate explanation of it is that the particles of earth, owing to the shape of their faces, are hardest to disturb from equilibrium (*τὰς βάσεις ἀσφαλεστάτας ἔχει*).

55 e 3–7. **βάσις δὲ . . . βέβηκεν.** *τριγώνων* is a genitive of description, 'a face *consisting in*', and this is further accompanied by a second genitive of the same kind, *πλευρῶν*. The sense then is 'a face consisting of such isosceles triangles as we began by postulating is naturally more stable than a face consisting of such scalene triangles as we began by postulating'. T. does not mean that the square, which is composed of the isosceles triangles, is more stable than the equilateral triangle, which is composed of the scalene triangles. This will be stated in the next clause. The present words simply mean that the right-angled isosceles triangle itself is more stable than the right-angled scalene.

55 e 6–7. **κατά τε μέρη καὶ καθ' ὅλον.** A.-H. goes wrong here by supposing that the *καθ' ὅλον* refers to the *solid* figures which are ultimately constructed from the triangles. This is shown to be impossible by the fact that it is plane figures, the *τετράγωνον* and *τρίγωνον*, which are the terms of the comparison. M. rightly explains that the *μέρη* mean the two types of elementary triangles, the *ὅλον* the larger figure, square or equilateral triangle, made by putting the elementary triangles together. The two statements made by T. are (1) that it is easier to upset a thing with the *ἡμιτρίγωνον* for its base than a thing with the *ἡμιτετράγωνον* for its base, (2) that it is easier to upset a thing which has an equilateral triangle for its base than a thing which stands on a square base.

56 a 1–c 7. **διὸ γῇ μὲν . . . ἀνὰ λόγον.** Of the three remaining figures we may reasonably ascribe that which is most stable to water, that which is least stable to fire, and the intermediate figure to air. Also it would be natural to suppose that the figure whose angles are sharpest belongs to fire, that whose angles are bluntest to water, and further that the particles of smallest volume are those of fire, the largest those of water. All these probabilities will be preserved if we suppose that the tetrahedron is the particle of fire, the octahedron of air, and the icosahedron of water. We save all the appearances by assuming that the particles of fire are those which have the fewest, those of water those which have the most numerous equilateral triangular faces.

In the case of the three figures which are being compared, all of them regular solids with equilateral triangles for faces, the three characters specified will go together, the figure with the fewest faces will be at once the smallest, the most unstable, and the sharpest pointed. Hence in the end it is the number of faces in the corpuscle which determines the differences between fire, air, and water. Note how careful T. is to remind us again that the whole combination is a provisional hypothesis (*τὸν εἰκότα λόγον διασῴζομεν*, 56 a 1).

56 a 6. **ὀλιγίστας** means 'fewest' (as A.-H. says in his note), not

'smallest'. Since all the equilateral triangles are made from the *same* ἡμιτρίγωνον, the faces will all be 'equal'. (The variation in size of the particles of each root, afterwards introduced, is a further refinement which is not anticipated here. As we have heard nothing of this so far, we must suppose Timaeus to be saying that with the triangles supposed to be all of one size, the particles which have fewest faces are least voluminous.)

56 b 4–5. τὸ μὲν τῆς πυραμίδος στερεὸν γεγονὸς εἶδος. τῆς πυραμίδος is a defining or descriptive genitive, the figure of the pyramid, i. e. 'the figure which is the pyramid'. στερεὸν γίγνεσθαι is the regular phrase for 'to receive a third dimension', 'to acquire depth'. One or two examples will suffice. At *Politics* E. 1316ᵃ7 Aristotle is discussing the famous passage of *Rep.* viii. 546 about the number which determines 'better and worse births', and uses the phrase ὅταν ὁ τοῦ διαγράμματος ἀριθμὸς στερεὸς γένηται. As Adam has shown (*Republic* ii. 306–12) this means 'when the number represented by the diagram becomes three-dimensional', i. e. is 'cubed'. So the writers on arithmetic call numbers which can be resolved into three factors 'solid' (στερεά), cf. Theo Smyrnaeus 41, 8 (ed. Hiller) ἔτι τῶν στερεῶν ἀριθμῶν οἱ μὲν ἴσας πλευρὰς ἔχουσιν . . . οἱ δ' ἀνίσους, Nicomachus Geras. (Hoche) p. 86, 16 ἡ μὲν μονὰς ἀρχὴ παντὸς ἀριθμοῦ ἐφ' ἓν διάστημα κατὰ μονάδα προβιβαζομένου, ὁ δὲ γραμμικὸς ἀριθμὸς ἀρχὴ ἐπιπέδου ἀριθμοῦ ἐφ' ἕτερον διάστημα ἐπιπέδως πλατυνομένου, ὁ δὲ ἐπίπεδος ἀριθμὸς ἀρχὴ στερεοῦ ἀριθμοῦ ἐπὶ τρίτον διάστημα πρὸς τὰ ἐξ ἀρχῆς βάθος τι προσκτωμένου, Euclid *Element.* vii, def. 18 ὅταν δὲ τρεῖς ἀριθμοὶ πολλαπλασιάσαντες ἀλλήλους ποιῶσί τινα, ὁ γενόμενος στερεός ἐστιν. So the whole phrase means 'that three-dimensional figure which is a pyramid'. στοιχεῖον is used with full sense of its literal meaning, the 'letter of the alphabet' which spells out fire.

56 b 6. τὸ δὲ δεύτερον κατὰ γένεσιν. That is, second in the order of construction from the elementary triangles, as given 54 d—55 b, which was the order of number of triangular faces used. The octahedron is meant.

56 b 7–c 2. δεῖ διανοεῖσθαι σμικρὰ οὕτως ὡς . . . οὐδὲν ὁρώμενον. For this use of accusative absolute in the place of genitive absolute with ὡς, when the principal verb is one which denotes or implies 'thinking that', see Madvig *Greek Syntax* (E. Tr.) § 182, p. 168. The 'anacoluthon' by which the construction then passes into accusative and infinitive at τοὺς ὄγκους ὁρᾶσθαι is of a type common in Plato's later writings, particularly in the *Laws*.

56 c 3–7. τὸ τῶν ἀναλογιῶν περί τε τὰ πλήθη . . . ἀνὰ λόγον. The construction with περί and the accusative in the same sense as a dependent genitive is very common in Plato's latest style, apparently as a device for avoiding an awkward accumulation of genitives, 'as to the proportions between their numbers, between their movements, and between their qualities in general'. Strictly the words from τὸ . . . δυνάμεις should be the object.-accus. with συνηρμόσθαι, but when we get to the verb, owing to the intervention of the parenthetical clause ὅπηπερ . . . ὑπεῖκεν, the object is resumed by a ταῦτα, so that what should have been the object.-accus. is left in a sort of anticipating apposition. This is the explanation of a very large number of what used to be called in the bad old language of our grammars 'accusatives of respect' in Plato's prose. The

reference in the ἀναλογιῶν can hardly be simply to the ἀναλογία given at 32 b, earth : water : : water : air : : air : fire, especially as Timaeus is speaking here only of the three 'roots' whose particles are built up with the ἡμιτρίγωνα. He means that there are many precise laws of relation between the numbers of the three kinds of particle, their various movements and their other properties, but he does not profess to be able to state all these laws. Our 'chemical formulae' would be examples of what he means.

56 c 5. ἑκοῦσά πεισθεῖσά τε. There is a suggestion that the 'compliancy' of ἀνάγκη is not absolute. 'When ἀνάγκη submits', you get minute and exact conformity to a recognizable law—this is the point of the δι' ἀκριβείας—but when ἀνάγκη is not sufficiently compliant, you get only imperfect approximation to this ideal. Consider e. g. the case of 'Boyle's Law' for the relation between pressure and volume in a gas kept at constant temperature. The formula $pv = k$ has the simplicity about it which Timaeus would recognize as indicating the persuasive influence of νοῦς; it is, so to say, transparent. It lends itself readily to purposes of mathematical manipulation; it can be expressed graphically by a very simple curve, the equilateral hyperbola, which seems to enable sense itself to take in the relation between the variations of p and v over a wide range at a glance. Thus the formula has the impress of νοῦς or God on it. But it does not describe the 'appearances' sufficiently exactly except when the compression of the gas is 'not too great'. For a gas under 'great compression' the formula has to be replaced by a less simple and manageable one, and the graph of this formula is much more irregular than the beautifully symmetrical equilateral hyperbola. (Cf. Nernst-Schönfliess *Einführung in die mathematische Behandlung der Naturwissenschaften* 34–5.) Why does the more elegant and simple formula fail us just at the point where it does? Why are values of p beyond this point 'too much'? This is the sort of question to which we find in the end no answer; we are left with the 'brute fact' that just at this given point we must complicate our formula.

56 c 8—57 c 6. ἐκ δὴ πάντων . . . τόπον. Timaeus now proceeds to propound an hypothesis about the fundamental laws which regulate the decomposition of the particles of the 'roots' and the recombination of their constituents in new forms, i. e. the laws under which the transformation of 'roots' is possible. We might fairly call the scheme a sketch of the mathematical chemistry of the 'elements'. The underlying principles are stated quite simply, but there are some difficulties about the tacit implications of the scheme which will need discussion. The general principle is that earth, not being formed from the same elementary triangle as the rest, is commutable with none of them. The others are all commutable with one another, the supreme law which regulates all the transformations being that the number of equilateral triangular faces remains the same after a mutation as before it.

56 c 8. ἐκ δὴ πάντων ὥνπερ τὰ γένη προειρήκαμεν. This is the reading of A. FYW have ὧν περί, and the *diorthotes* of A indicated this as a correction. Of the modern editors Bt. stands alone[1] in printing ὥνπερ. Yet it seems

[1] (But he has since been followed by Rivaud.)

to me that ὧν περί is almost certainly a *correction* of the *lectio difficilior*, and as such deprived of authority. If we adopt it we must suppose that the construction is ἐκ πάντων ἃ προειρήκαμεν περὶ τὰ γένη, with the common 'attraction' of the ἅ to the case of its antecedent πάντων, 'from all we have already said about the kinds of particles'. Thus we have προλέγειν περὶ τὰ γένη where we should normally have expected περὶ τῶν γενῶν. This is unusual, but not impossible. Cf. πράττειν περί in such a phrase as *Gorgias* 507 a 7 καὶ μὴν ὅ γε σώφρων τὰ προσήκοντα πράττοι ἂν καὶ περὶ θεοὺς καὶ περὶ ἀνθρώπους. Still the phrase is not quite usual and one tends to suspect a v. l. which introduces it. If we keep the ὥνπερ, πάντων cannot be the antecedent to the relative. ἐκ δὴ πάντων will = 'on the whole account', 'everything being considered', and the antecedent to ὥνπερ will be an understood ταῦτα which will be the subject of ἂν ἔχοι. 'On the whole account, the things whose kinds we have already named in all probability behave as follows.' Since a sentence of this kind would almost certainly be misunderstood from the assumption that πάντων is antecedent to ὥνπερ and then 'corrected' by the substitution of ὧν περί, I think ὥνπερ has the better claim to be regarded as the genuine text, but it would be advisable to punctuate with a comma after πάντων to avoid misapprehension of the grammar.

56 d 1–6. γῇ μὲν . . . ποτ' ἄν. The first of Timaeus's laws of chemical transformation is that if earth is broken up by being pierced by the sharp angles of the tetrahedra of fire, it 'drifts about' (φέροιτ' ἄν) in the surrounding 'medium', whether that medium is fire, air, or water, without entering into any new combination, until the 'fragments' (μέρη) coalesce together (πῃ συντυχόντα τὰ μέρη πάλιν συναρμοσθέντα αὐτὰ αὑτοῖς) and 'become earth' again. What is being contemplated is the disintegration of a cubic molecule of earth, not the mere separation of one cube from another by particles of fire which have got in between them. The actual cubes are thought of as broken up into their constituent faces, or into the elementary triangles of which the faces are composed. If this takes place, then, on the general principles of T.'s doctrine, the only possible consequence is what he describes. The floating squares or ἡμιτετράγωνα cannot combine with the 'medium' in which they find themselves, as it is composed of the other kind of elementary triangles. They can only 'drift' loose until some of them coalesce to form cubes again. In the interim they are neither earth nor any other known body. They are just drifting plane figures of a certain geometrical structure. This is not the only example of the disintegration of particles into something which cannot be classified as one of the 'four bodies'. We shall see that when water becomes air or air water, it is supposed to go through transitional stages in which it has not the definite structure of any of the 'roots'. Note also that, as usual at the opening of a fresh section of the cosmology, we are carefully reminded of the provisional character of our theory. It is simply 'what is most probable' (τὸ εἰκός).

56 d 3. ἐν ὕδατος ὄγκῳ. That earth and fire may come into contact in water will appear intelligible at once when we remember that T. regards a liquid mass of metal at an enormous temperature as 'water'.

56 d 5. εἶδος. Here quite definitely of geometrical 'pattern'. It is

the impossibility of transforming the ἡμιτετράγωνον into any other 'figure' which is the whole explanation of the behaviour of 'earth'. You can't make anything but cubes with it.

56 d 6–e 7. ὕδωρ δὲ . . . συμπαγές. We now come to the three 'roots' which are all constructed from the ἡμιτρίγωνον and therefore can be converted into one another. The transformation is subject to definite numerical laws, which, in the end, reduce to the one law that under all transformations the *number* of the equilateral triangular faces involved remains constant. A particle of water has 20 faces, one of air has 8, one of fire 4. Hence we get the following results. (1) A particle of water, broken up by air or fire, may be reformed as 1 particle of fire + 2 particles of air (since $20 \times 1 = 4 \times 1 + 8 \times 2$). (2) A particle of air may similarly be converted into 2 particles of fire (since $8 \times 1 = 4 \times 2$). (3) If a small quantity of fire is bombarded by a mass of other 'roots', 2 particles of fire may combine to form 1 of air ($4 \times 2 = 8 \times 1$). (4) $2\frac{1}{2}$ particles of air may be reformed as 1 of water $\left(\frac{8 \times 5}{2} = 20\right)$. These are what we may call the four fundamental chemical formulae of T.'s scheme. The one thing which remains constant in the transformations is the number and shape of the faces of the particles. The square faces of the cubes of earth cannot be reformed as equilateral triangles, the equilateral triangles of the other 'roots' always remain equilateral triangles, and the total number of them is constant through all chemical change. The constancy of this number plays the same part in the theory that fixed proportions by weight have done in modern chemistry since Dalton. The main thought of Dalton's doctrine, as of T.'s, is the thoroughly Pythagorean one that in all transformations there are absolutely invariant numerical relations.

56 d 7. συστάντα. The subject is singular ὕδωρ, but the participle agrees in number, according to a common usage, with the 'complement' composed of ἓν μὲν πυρὸς σῶμα, δύο δὲ ἀέρος. Nearly parallel is such a phrase as *Meno* 91 c 4 οὗτοί γε φανερά ἐστι λώβη τε καὶ διαφθορὰ τῶν συγγιγνομένων. (See Matthiae *Greek Grammar* [E. Tr.] iii, § 309, Madvig *Greek Syntax* [E. Tr.] § 4.) συστάντα is also correct as to meaning. The new particles are 'formed' by a *combination* which follows on the dissolution of the old one.

56 e 5–7. ἓν . . . εἶδος ἀέρος . . . ὕδατος εἶδος ἕν. εἶδος here, though strictly meaning the 'figure' in question, is virtually hardly distinguishable in meaning from 'one body', and might most conveniently be rendered 'particle'.

We have now to consider some difficulties which have been raised about the real nature of the process described in the passage 56 c 8–e 7. Of Aristotle's unfavourable criticisms on what he treats as a preposterous attempt to construct bodies out of mathematical planes it will be more convenient to speak when we have reached the end of this section of T.'s discourses. But something must be said about a difficulty over which C. W. (*On the Interpretation of Plato's Timaeus* pp. 50–1) has an acid criticism of A.-H. Martin pointed out that if we think of the particles of T.'s theory as indestructible bits of matter (like Newton's

'hard corpuscles'), the combinations described cannot possibly take place.[1] E.g. if you split an octahedron in two by a section through its median plane, you do not get two tetrahedra. You get two bodies which have five faces apiece, four of them equilateral triangles and the fifth a square. This is obvious, and C. W. has no right to treat it as an 'inconsistency in detail, overlooked by Plato'. If it is the sort of thing I, for example, can see at once for myself, it is incredible that the founder of the Academy and friend of Theaetetus could not see it. Similar difficulties occur about the other transformations. Hence the 'particles' cannot be what a Newtonian would understand by bits of hard matter occupying space. Martin's own view was that Plato means the 'planes' of the construction to be very thin laminae of matter, so that each particle is, in fact, a hollow shell. If this were the case, all the transformations would be feasible. In splitting the octahedron you would not produce a fifth side which is square, because the octahedron is hollow inside. You would have just the two sets of triangular laminae, and these could be regrouped as two tetrahedra.

A.-H. objects to M.'s view as M. stated it, but, as it seems to me, puts his objection badly. He is not entitled to reject M.'s interpretation on the ground that Timaeus does not recognize the existence of 'empty space'. That there is κενόν in things is so explicitly asserted later on in the dialogue that A.-H. himself has to retract his own contention by saying that Plato does not absolutely deny the existence of 'void'. And no thinker is exempt from liability to oversights. But both A.-H. and C. W. forget that it is not Plato who is delivering the lecture on cosmology but Timaeus. If Timaeus is at times inconsistent, Plato is not necessarily answerable for the inconsistencies. He may have even introduced some of them deliberately. It is neither our business as interpreters to declare, with A.-H., that there are no inconsistencies in the dialogue nor, like C. W., to argue that Plato must have been blind to any that there are. The whole question is about the character of a suspected inconsistency. The particular inconsistency into which C. W. supposes Plato to be falling about the transformations of the corpuscles is one which could only be committed by a person who was quite unfamiliar with the forms of the regular solids. That, and not the mere fact that it would be an inconsistency, is the reason for feeling reasonably sure that it does not exist. If it did, we should have to suppose that it was introduced on purpose. But, again, it is hardly credible that Plato should represent the most eminent Pythagorean men of science of the time *c.* 420 B.C. as making this particular blunder. We are therefore justified in refusing to believe that it is to be found in the dialogue until it is absolutely proved that there is no alternative. We must, for many reasons, however, try to find some better way out of the difficulty about the combinations described than that of either A.-H. or M. The Pythagoreans were notoriously the great assertors of the κενόν or void among the early cosmologists, and there can be no serious doubt that it was from them that the Atomists learned to make it a prominent feature in cosmology. It is they, as well as Leucippus and Democritus, whom Aristotle specially sets himself to confute in his own polemic against the reality of τὸ κενόν

[1] Martin, *Études*, ii. 253 (*note* 75).

in *Physics* Δ. Thus, at Δ. 216^{b} 25, he quotes the argument of the Pythagorean Xuthus that if there were no void, the world would 'boil over' (ἡ κυμανεῖ τὸ ὅλον, ὥσπερ ἔφη Ξοῦθος); at 213^{b} 22 he explains more precisely that the Pythagorean view is that the world is surrounded by an infinite void from which it 'inhales' the empty intervals which keep the things in it apart (εἶναι δ' ἔφασαν καὶ οἱ Πυθαγόρειοι κενόν, καὶ ἐπεισιέναι αὐτῷ τῷ οὐρανῷ ἐκ τοῦ ἀπείρου πνεύματος ὡς ἀναπνέοντι καὶ τὸ κενόν, ὃ διορίζει τὰς φύσεις . . . καὶ τοῦτ' εἶναι πρῶτον ἐν τοῖς ἀριθμοῖς· τὸ γὰρ κενὸν διορίζειν τὴν φύσιν αὐτῶν). It is in keeping with this that the great mistake Parmenides charges on his opponents in the fragments of his poem is that they believe in the reality of empty space. Hence we should antecedently expect to find Timaeus asserting rather than denying the existence of κενά, and our expectation will turn out to be verified. On the other hand, A.-H. is clearly right in saying that 'matter' plays no part whatever in the cosmology of Timaeus, who constructs the sensible world simply out of events which are 'sensibilia' occurring through volumes. Hence M.'s view, since, as he states it, it turns wholly on the admission of 'matter' in the form of the 'thin laminae', cannot be what T. really means to assert. But A.-H.'s further attempt to support his case by appealing to the use of στερεόν at 56 b 5 is mistaken. στερεόν there, as throughout, means only 'having three dimensions', and a particle such as M. conceives, a hollow shell, is in this sense στερεόν. Thus A.-H. has really no coherent view of his own. He is not clear whether he wishes to prove M. wrong on the ground that the particles of Timaeus are simply volumes in which events go on, and consequently have no outside plating of 'matter' (this would have been the right line to take), or on the different and mistaken ground that they are 'hard matter' to the core. M. has the merit of meaning something quite definite, and something which would make the transformations of 56 d–e possible. I believe we shall see that it is even possible to restate the substance of his view in a way which would remove the fatal objection to his own formulation of it. So far as A.-H. suggests a real view, it seems to me a wrong one. He speaks of the shape of the particles being changed by 'pressure', and implies that something like Boyle's law for the relation between pressure and volume holds for the particles. 'Increasing the pressure' is to make e. g. two tetrahedrons appear where there was before one octahedron. But Timaeus says nothing whatever in this connexion about 'pressure', and I believe I shall be able to show that in the other place in the dialogue where A.-H. finds a reference to a certain terrific 'pressure' on the particles (58 a 7) he has only got the 'pressure' into his version by a mistranslation. It is not by a 'force of pressure', but by the sharpness of the angles of a particle that T. accounts for the splitting up of a particle with blunter angles which encounters it. In fact, if the suggestion about 'pressure' be taken seriously, one may propound the following trilemma. If the particles subjected to pressure are absolutely hard in Newton's sense, pressure will not alter them; if they are what M. supposes, pressure should *deform* them, and we cannot expect that the equilateral triangles which are their shells should retain their form and size unaltered. If they are purely geometrical volumes there is nothing to compress.

A.-H. forgets that pressure implies resistance to pressure, in fact inertia. He thus falls between two stools. He will not admit to Aristotle that the particles of T. are purely geometrical, nor to M. that they are not purely geometrical. The resulting statement that the 'planes' out of which they are built up are neither 'planes out of which we are expected to construct solids' nor yet their laminae, but 'laws of the structure of matter' seems to have no intelligible meaning.

In trying to explain the theory more intelligibly we have to be careful not to introduce any implied reference to such concepts as inertia, pressure, mass. It is unhistorical to import into the *Timaeus* a class of notions which have come to us, through the books we read on physics at school, from Newton's *Principia*. On the other side, we must not introduce from Aristotle the notion of 'matter' as a 'substratum' of events. Aristotle is quite explicit on the points that Timaeus knows of no 'matter' distinct from χώρα, and that he seriously constructs 'bodies' such as fire and water out of geometrical triangles. In fact a real distinction between space and matter cannot be worked out without introducing the notion of *mass*, or, as Newton called it, 'quantity of matter', and no one ever clearly formulated this notion before Newton's *Principia*. Descartes, for example, regarded matter as so much geometrical extension, exactly as Timaeus does, as we can read for ourselves, e. g. in the *Second Meditation*, precisely because he knew nothing of the mechanical significance of mass, momentum, and *vis viva*. Leibniz indeed saw that *vis viva*, a quantity proportional to the second power of the velocity of a moving particle, is of fundamental importance in mechanics, and drew the inference that the Cartesians were wrong in thinking that volume is the one and only 'essential' character of matter, but even Leibniz never reached a clear idea of what we call the *mass* of a body (a quantity proportional not to its volume but to the product of its volume and its density), and consequently never formed satisfactory notions of momentum and *vis viva*. The real fault of M.'s explanation, as it stands, is that its distinction between the 'thin material laminae' and the interior of the particles tacitly smuggles in the Newtonian concept of mass. Since Timaeus knows nothing of 'matter', what is wanted is that his theory of the laws of combination of the 'roots' should be stated in a way which (1) is consistent with the truth of the formulae he gives, (2) presupposes nothing but the concepts with which he is avowedly working, viz. events, the volumes in which they go on and the παραδείγματα. What we clearly need, as M. says, is the distinction between 'empty' and 'filled' space, but we must not make the distinction by means of the notion of 'matter' either in Aristotle's sense of the word or in Newton's. If we restate M.'s theory in a way which gets the Newtonian 'matter' out of it, I think we shall see that it gives a correct account of what Timaeus intends to say. 'Empty space' may be defined without bringing in this notion of matter quite simply by saying—and this is virtually Dr. Whitehead's version of the distinction—that 'occupied space' means a region in which something is going on of the *kind* that our senses can reveal. Empty space is space where there is nothing going on of the kind our senses reveal. It does not follow that nothing at all is going on there. The region

which is 'empty' in this sense may be an electric field in which the most important things are going on all the time, only they are not the *sort* of process which *we* apprehend directly through sense. Thus we understand what physicists mean when they say, like Professor Eddington, that the most important physical occurrences in nature are those which go on in 'empty' space, i. e. in spaces where there are no 'masses'. We see also that we can thus admit the reality of empty space in the only sense in which it seems to be required by physical science without asserting the existence of a something which is indistinguishable from nothing, the blunder denounced by Parmenides. Now as Timaeus does not employ the notion of 'matter' as a 'substratum' of sensible qualities, he will not be contradicting any of his own presuppositions if he should imply merely that there is a distinction between regions where something 'sensible' is going on and regions where nothing 'sensible' is going on. The κενά, understood in this way, will fit perfectly into his general theory. Now we, of course, only see and touch surfaces; we do not apprehend their 'insides' by sense. Therefore, if by calling the interior of one of T.'s particles 'hollow', it is only meant that all we perceive is what is going on at the surface, and that nothing 'sensible' goes on in the interior, M.'s view that the particles are hollow would fit in with all that Timaeus teaches. Only, if we speak, as M. does, of their surfaces as 'material', we must simply mean that events of the *kind* which our senses perceive go on at the surfaces.

There still remains *one* arbitrary assumption in the theory. The arbitrary assumption is that in any regrouping which gives us a new set of surfaces (a rearrangement of 'sensibles') the number, shape, and size of the surfaces themselves are unchanged. There is no logical necessity for this assumption, but it is quite legitimate if we remember that the whole theory is avowedly put before us as a provisional ὑπόθεσις from which we can deduce the body of appearances at present known to us. Since Timaeus holds that in physical science you can never do more than propound an undemonstrated set of 'postulates', and that the merit of such a set consists wholly in the completeness and system with which the 'appearances' can be shown to follow from it, he is at liberty to start with whatever 'postulate' he pleases. He is only bound by the rules of method to choose the simplest and fewest assumptions from which the 'appearances', so far as known, follow as conclusions.

56 e 7—57 c 6. The theory of the transmutations may be more briefly recapitulated. When particles of the other kinds are broken up by fire, equilibrium is restored if they can be reformed as tetrahedra and so converted into fire, for like does not act physically on like. But so long as this consummation is not reached, if the fire itself continues to persist, the process of 'breaking up' the other particles continues too. Similarly when a lesser number of smaller particles are intercepted among a greater number of larger ones, the series of transformations comes to an end if the smaller particles can be transformed into the figure (ἰδέα) of the more numerous larger ones, but not otherwise. There are only two possible results of the conflict between particles of different type. Either the particles of the one type are eliminated and find their way to the main cosmic mass of their own type, or one of the conflicting types

is assimilated to the other. These processes lead to a constant shifting of particles from one region (*χώρα*) to another.

In this recapitulation T. does perhaps fall into an inconsistency, but it is a pardonable one. He lays it down (57 a 3–5 *τὸ γὰρ ὅμοιον . . . ὁμοίως τε ἔχοντος*) that no particle can produce any change in one of the same kind or undergo any change from the action of a particle of the same kind, because 'like cannot be modified by like'. (This seems of itself to show that the tremendous 'constrictive force' imagined by A.-H. really plays no part in the theory.) Is this quite consistent with the doctrine that 'like perceives like', of which he has made use in the *ψυχογονία* and, following Empedocles, in his theory of vision? You may say, with A.-H., that the *present* theory 'like cannot modify like' applies only to physical processes. But does this really remove the difficulty? Is not the fusion of the ray of light issuing from the eye with the 'kindred' light outside, by which vision was explained, a physical process? It seems to me that there is an inconsistency between holding as a doctrine of physics, as Aristotle says all the *φυσικοί* except Democritus had held, that like cannot act on like (*de Generatione* A. 323^{b} 10 *Δημόκριτος δὲ παρὰ τοὺς ἄλλους ἰδίως ἔλεξε μόνος· φησὶ γὰρ τὸ αὐτὸ καὶ ὅμοιον εἶναι τό τε ποιοῦν καὶ τὸ πάσχον κτλ.*), and yet maintaining the Empedoclean psychological, or rather psychophysical, doctrine that 'like perceives like'. We know that E. explained this by the view that effluxes 'fit into' the 'pores' of that which is of the same make with themselves. But obviously, if this is to explain perception, there must be *some* physical action of the 'efflux' on the organ into whose 'pores' it has found its way. If there is an inconsistency it is one which was actually committed by most of the *φυσικοί*. Aristotle (*supra*) says that Democritus stood *alone* in thinking that like can act physically on like. Theophrastus, in the *de Sensu*, where he tries to classify the various theories of perception under the main rubrics of perception of like by like and perception of opposite by opposite, mentions only Anaxagoras and, if the text is sound, Heraclitus as holding the second view (*de Sensu* 1, *Doxogr.* 499 *οἱ δὲ περὶ Ἀναξαγόραν καὶ Ἡράκλειτον τῷ ἐναντίῳ*). Empedocles and Plato, by whom he means the *Timaeus*, the only dialogue criticized in the *de Sensu*, are placed by him definitely, and Diogenes of Apollonia (ib. 39, *Doxogr.* 510) inferentially, in the 'likeness' party. Of Democritus we are told that he might be interpreted either way as he had said nothing definite on the question (ib. 49, *Doxogr.* 513 *Δημόκριτος δὲ περὶ μὲν αἰσθήσεως οὐ διορίζει, πότερα τοῖς ἐναντίοις ἢ τοῖς ὁμοίοις ἐστίν*). Theophrastus felt that the combination of the theory 'like perceives like' with the view that 'like produces no physical change in like' is not quite consistent, for he goes on at once to say that D.'s view that like acts physically on like, as far as it goes, would be an indication that he supposed like to perceive like (*εἰ μὲν γὰρ ⟨τῷ⟩ ἀλλοιοῦσθαι ποιεῖ τὸ αἰσθάνεσθαι, δόξειεν ἂν τοῖς διαφόροις . . . πάλιν δ' ⟨εἰ⟩ τὸ μὲν αἰσθάνεσθαι καὶ ἁπλῶς ἀλλοιοῦσθαι ⟨τῷ⟩ πάσχειν, ἀδύνατον δέ, φησί, τὰ μὴ ταὐτὰ πάσχειν . . . τοῖς ὁμοίοις*). Thus the inconsistency was common in the fifth century, and it is quite natural that T.'s fusion of mathematics and Empedoclean biology should lead to such things. Whether Plato himself felt any inconsistency we cannot decide.

57 a 4. οὔτε τι παθεῖν. If we are anxious to deny that there is any inconsistency, we may perhaps compare this with 45 d 4 (of the 'visual ray') *πρὸς γὰρ ἀνόμοιον ἐξιὸν ἀλλοιοῦται*, 'has its quality altered', and say that the *fusion* of like with like is not *ἀλλοίωσις*, whereas the *παθεῖν τι* may be taken as equivalent to *ἀλλοιοῦσθαι*. This would be a better defence then to draw a distinction between 'psychological' and 'physical'.

57 a 5-6. εἰς ἄλλο τι γιγνόμενον, simply 'turning into something else', as contrasted with *συστὰν μὲν εἰς τὴν ἐκείνου* (sc. *τοῦ πυρὸς*) *φύσιν supra*, not 'se trouvant *introduit* dans un autre (*sc.* corps)', as M. renders. (Would this not rather be *ἐν ἄλλῳ τινὶ γιγνόμενον*?) M.'s rendering misses the point that T. is speaking of a series of successive *transformations*. And *ἄλλο τι* is made unmeaning, for the case we are still considering is that of 'fire' surrounded by *any γένος* other than itself. Cf. Theognis 164 *οἷς τὸ κακὸν δοκέον γίγνεται εἰς ἀγαθόν* ('turns out for good').

57 b 4. ἐὰν δ' εἰς ταὐτὰ ἴῃ. Here the *ταντὰ* of F, *ταῦτα* of Y and W, means *ταὐτά*, and the reading is another example of a case where A, which has *αὐτά*, is wrong, though it is that of the modern editors before Bt. With *εἰς αὐτά* the metaphor would be, as Stallbaum explains, military, like that of *μαχόμενα*, 'when they come into conflict with them'. But this should perhaps rather be *ἐπ' αὐτά*. I think *εἰς ταὐτὰ ἰέναι* means 'come to an agreement', 'come to terms'. Cf. e.g. *Apology* 36 c 1 *ἡγησάμενος ἐμαυτὸν τῷ ὄντι ἐπιεικέστερον εἶναι ἢ ὥστε εἰς ταῦτ' ἰόντα σῴζεσθαι* ('to preserve my life by coming into these terms'). The point is that if even 'fire and water' do 'come to terms', one side surrendering to the other, there may be particles of a third kind left, which have not 'come in', and the 'battle' is continued. It does not cease until either all the combatants 'submit' to the strongest or all are beaten back to their respective 'main bodies'.

57 b 5-6. πρὶν ἢ . . . συγγενές. The alternative to this successful assimilation of one 'root' by another is that whatever cannot be transformed is left to drift *πρὸς τὸ συγγενές*, i.e. in the direction of the region of the general aggregate whose particles have the same structure. As we saw (53 a) the effect of undirected random movement all over space is to sort particles of one size and shape together. The recurrence to the persistence of this tendency in the actual *οὐρανός* is one of the indications that when T. speaks of the state of things before the 'roots' were made he means that the state described is what would be the inevitable consequence of unguided movement in the natural world, if actual motions *were* left without intelligent guidance. But for the laws which make the transformations of the 'roots' possible, this 'drifting' would be the only actual movement, and the result would be a steady monotonous sifting out of particles into four great layers, in distinct regions of space, the particles of each heap having approximately (cf. the *ἴχνη αὐτῶν ἄττα* of 53 b 2) or 'on the average' the same size and shape. Thus it is the restriction of this random motion by the definite conditions expressed in the laws of atomic combination which explains why there is a world of different interconnected and interacting things, and not a plurality of layers of corpuscles, those of each layer having, within a certain range

of variation, roughly the same structure. The 'like to like' movement, which, left to itself, would produce this last result, actually exists. We have been told already that it is found when the cubes of earth are broken up by 'fire' and their faces drift until they meet with others along with which they can be united into cubes again. But in the actual world the 'drift' is only an undercurrent of 'tendency'. The object of the professed description of the original chaos is to show how this tendency would work out if it were not restricted by intelligent design. The physical truth which Timaeus has firm hold of throughout is that the existence of an ordered world depends on the presence of 'differential motions'. Hence it is vain to try, like e. g. Spencer in *First Principles*, to get the world out of an absolutely 'homogeneous' nebula in which there are *no* differential motions. Or, to put it differently, the life of the world depends on the existence of different levels of 'energy'. Energetic transactions will not take place except between systems which are on a 'different level'. E. g. thermodynamical transactions only take place between bodies of different levels of temperature. If all the 'energy' in the universe were converted into actual kinetic energy (as physicists sometimes prophesy will happen at some remote date), we should have space filled with a uniform temperature, and no more 'work' would be done. 'History' would have come to an end, and there would no longer be a 'world' at all. In this sense we can give a very real meaning to the vague old proposition that 'like' cannot interact with 'like', but only with 'unlike'. And as there would no longer be any 'world' if all 'energy' were uniformly distributed through space, so you cannot 'evolve' a 'world' out of such a 'homogeneous'. Spencer only seemed to achieve the fact by denying the principle of conservation of angular momentum (Ward, *Naturalism and Agnosticism*, vol. i, lecture 7).

57 b 6. ἓν ἐκ πολλῶν. A.-H. says this can only refer to the case when the 'victor', the 'root' which assimilates another, is that which has the larger particles. It could not take place when the octahedrons of 'air' are all split by the tetrahedrons of 'fire' and the mass is reformed as a homogeneous body of 'fire'. But the reference is more general, and is not really to the combination of several *particles* into a larger particle in particular. All that is meant is that the *aggregates* of the particles of different 'roots' are reformed into one homogeneous mass of a single 'root'. If the octahedra of the air are *all* divided into tetrahedra, what was before a region occupied by fire and air is now occupied only by fire. This is what is meant by ἓν ἐκ πολλῶν γενόμενον. It makes no difference to the unification whether it has been effected by turning octahedra into tetrahedra or tetrahedra into octahedra. All cases of complete 'assimilation' are included; τῷ κρατήσαντι means 'the predominant root', whichever it may happen to be.

57 b 7. σύνοικον. 'Keeps house with' τὸ κρατῆσαν. The picturesque metaphor should not be allowed to be lost in translation. The word is used of different families or stocks who join in 'colonizing' a district, and that is what is meant here. Thus, according to Hdt. i. 57, the Pelasgians σύνοικοι ἐγένοντο Ἀθηναίοισι in certain places on the Hellespont.

57 c 3. διὰ τὴν τῆς δεχομένης κίνησιν. The tense of the participle is

right here. The *παθήματα* which lead to changes of direction of 'drift' are the transformations of the roots. A given mass of air is at first drifting towards the region where most of the air is. If it becomes fire, it then drifts towards the cosmic aggregate of fire, and so the direction of the motion is changed. The 'making of the roots' thus provides for numerous differential movements and prevents the course of events from being simply a drifting off of particles in four divergent directions, and this source of differential motions is not provided for by the mere existence of the drift, but superinduced on it by rational design. Professor Alexander attempts to get definite 'patterns' of motion out of an original state of chaotic drift (*Mind*, N. S. 120, p. 414), but he differs from Timaeus in cutting out the *δημιουργία* of *νοῦς* and referring everything to the *πλανωμένη αἰτία* working by itself, the 'restlessness of Space-Time', as he calls it (*Space, Time, and Deity*, ii. 348, cf. ib. 413). This philosophy might be much more correctly affiliated to Spencer than to Timaeus.

57 c 4–6. *φέρεται . . . τόπον.* This is precisely what happens in the theory of Empedocles during the half of the cycle when Strife (*νεῖκος*) is overcoming Love (*φιλία, φιλότης*). The final culmination, which only lasts for a moment, is the complete isolation of each 'root' on its separate dustheap. Timaeus is of the opinion that the process never really takes place on a large scale, the *οὐρανός* never is distintegrated, precisely because 'necessity' always is the 'understrapper' of *νοῦς*, so that the drift is only a tendency which never occurs uncompensated. The mechanics of the compensation arise from the laws of transformation of the roots'. They are continually passing into one another, hence the direction in which an aggregate is drifting is constantly changing. When one aggregate *A* has been assimilated to another *B*, it tends *πρὸς τὸν ἐκείνων οἷς ἂν ὁμοιωθῇ τόπον* and so gets a new direction of drift. Since the possibility of transmutation arises from the law of structure introduced by *νοῦς*, this constant shifting of the direction of 'drift', which compensates for the disintegrating tendency of the drift itself, is not due to anything in the 'blind forces' of the *κόσμος*, but is a direct consequence of 'guidance'. (Cf. the functions ascribed by Clerk Maxwell to his imaginary 'sorting demon', who can reverse the direction of a particle's motion without expenditure of energy. What the 'sorting demon' is imagined to do, as occasion arises for individual particles, *νοῦς* in Timaeus's scheme does once for all by reducing the particles to a strict geometrical pattern.)

57 c 7–d 6. *ὅσα μὲν οὖν . . . εἰκότι λόγῳ χρήσεσθαι.* This is an appendix to the last section. To give a satisfactory account of all the 'appearances' we require to assume that there is a certain variation in the size of the particles of the 'roots', and this again depends on difference of size of the constituent triangles. These variations are, however, confined within a definite range.

57 c 8–9. *ἐν τοῖς εἴδεσιν . . . γένη.* It is just these sub-varieties or sub-classes which are called in Aristotelian logic *εἴδη, species*, that are here called *γένη, genera*, so that the terminology of later logic exactly inverts that employed here. It might even be doubted whether *αὐτῶν* does not depend on *γένη* rather than on *εἴδεσιν*, in which case *εἴδεσιν* will have the literal meaning 'figure' or 'shape'. Or possibly *αὐτῶν* means

simply σωμάτων and εἴδεσιν 'particles'. (So Democritus wrote a work περὶ εἰδῶν, and is known to have called his atoms ἰδέαι, Plutarch. *adv. Colot.* 1111a, and there is a gloss in Herodian, ἰδέα, τὸ ἐλάχιστον σῶμα.) Probably Plato still felt the force of the metaphors in the two words, εἶδος, 'figure', and γένος, 'family'. Either can be used by him indifferently of anything we should call a 'class' or a 'kind'. It is just because our words genus and species are foreign, and have no associations (for we have long ago forgotten that 'spice' and 'species' are the same word), that we find it hard to connect any meaning with either except the artificial and technical meaning we have learned from our textbooks.

The existence of sub-varieties of earth, water, &c., is explained by the assumption that though the *form* of each kind of particle is fixed, its magnitude is variable, because the size of the primary triangles is variable; i. e. because figures can be 'similar and similarly situated' without being congruent. This is itself an immediate consequence of the uniformity of the ὑποδοχή on which Timaeus has already insisted.[1] We are free, therefore, to admit as many different sizes of the particles of the 'roots' as we may find requisite to do justice to the 'appearances'. And since the same volume may include particles of the same figure but different magnitudes, there are in nature not only a few well-marked variations among bodies but an indefinite number of less well-defined intermediate varieties. Thus, to recur to the image of the 'alphabet', we might say that there are differences in nature corresponding to the differences philology recognizes between the 'open' and 'close' and other sounds of the 'same' vowel. Nature's alphabet is no more rigidly 'phonetic' than that of any actual speech. This explanation was not needed earlier, but has to be given now because use will be made of these variations of size among particles of the same 'root' in some of the explanations of actual specific experiences which are to follow.

57 c 9. τὴν ἑκατέρου τῶν στοιχείων ... σύστασιν. The στοιχεῖα or *ABC* are neither the particles nor their triangular faces, but the two *ultimate* types of triangle from which both faces and particles have been built up. Hence ἑκατέρου, 'each of the *two*'. The 'particles of 'earth' are, therefore, like those of the other three, of various sizes. M. raises the question how these statements are to be reconciled with the former statement that the στοιχεῖα of the tetrahedron, octahedron, icosahedron are the same, and remarks that it is *sous-entendu* that there are fixed limits to the range of variability, such that no 'pyramid' is greater than any octahedron, no octahedron than any icosahedron (*Études* ii. 254, note 76). So also A.-H., though he expresses himself with less precision, rendering M.'s 'not greater than' by 'less than'. C. W. (pp. 50–1) has an unfortunate note here in which he tries to show that M. is wrong by appealing to 56 b 2 where 'fire' is said to be constituted ἐξ ὀλιγίστων τῶν αὐτῶν

[1] That is, T. regards it as such a consequence. In point of fact it will not be so unless we assume that the geometry is Euclidean. This has been assumed by implication at 53 d 2, where the angle-sum of the ἡμιτετράγωνον is given as two right angles. Timaeus has, in fact, committed himself to an equivalent of Euclid's 'parallel postulate'. See Appendix V on the *Geometry of Timaeus*.

μερῶν. This, however, does not quite prove what he wants it to prove, since the 'sameness' meant there is evidently simply sameness in form. All that T. says there is that the tetrahedron of fire is never greater than the octahedron of air or the icosahedron of water. This is obviously true if the 'triangles' of fire are smaller than or equal to those of water and air; it will be true universally if M.'s restriction on variations in size is understood, though not otherwise. We cannot therefore *assume* that Timaeus has no such reservation in his mind when he says what he does at 56 b 2. He may only be deferring the reference to variation until he reaches a point where it becomes necessary to mention the matter expressly. C. W. supposes *Plato* to have fallen into an oversight. I do not think this very likely. It is, I imagine, true that he could not have given the formulae for the volumes of the regular solids of a given edge. It is noticeable that in Euclid xiii. 18, though the sides of the regular solids inscribed in one and the same sphere are compared with one another, there is no comparison of volumes. This explains the existence of the so-called 'fourteenth book' of the *Elements*, a supplement dealing with this very subject. It appears from the opening words of [Euclid] xiv that the study of the problem began with Apollonius of Perga, who composed a lost work on the ratio of the volumes of the icosahedron and dodecahedron inscribed in the same sphere.[1] We may therefore assume that Theaetetus and his friends in the Academy had not fully solved the problem of comparing the volumes of regular solids of different form. But it is incredible to me that Plato should not have known that a tetrahedron is not necessarily of less volume than an octahedron, e. g. that a tetrahedron inscribed in a sphere is greater than an octahedron inscribed in a second sphere of half the diameter of the first. If we suppose this to be ignored, we must take it that Plato is consciously making Timaeus fall into a confusion of which he himself could not have been guilty. Even this does not seem likely. No one could seriously suppose that a tetrahedron *must* be smaller than an octahedron, no matter how much greater the size of the sphere in which the tetrahedron is inscribed. What Timaeus had actually said, therefore, at 56 b 2 cannot be pressed to mean more than that *if* the triangular faces of all three are equal, the tetrahedron will be less than the octahedron and that than the icosahedron. So much would be obvious to an intelligent child from the simple consideration that these relations are visibly true of the three when inscribed in the *same* sphere. I cannot doubt then that M. and A.-H. are right in supposing the subsequent recognition of a variability in the size of the triangles to be perfectly consistent with all that has gone before. C. W. forgets that the credit of Plato is not pledged for any of the εἰκότες λόγοι of Timaeus.

At the same time I do not feel sure that Timaeus was not tacitly making all through a false assumption rather different from that which

[1] [Euclid] *Element.* xiv *ad init.* (Heiberg v. 2) καί ποτε ζητοῦντες τὸ ὑπὸ Ἀπολλωνίου συγγραφὲν περὶ τῆς συγκρίσεως τοῦ δωδεκαέδρου καὶ τοῦ εἰκοσαέδρου τῶν εἰς τὴν αὐτὴν σφαῖραν ἐγγραφομένων, τίνα ἔχει λόγον πρὸς ἄλληλα, ἔδοξαν ταῦτα μὴ ὀρθῶς γεγραφηκέναι τὸν Ἀπολλώνιον, αὐτοὶ δὲ ταῦτα καθάραντες ἔγραψαν, ὡς ἦν ἀκούειν τοῦ πατρός.

C. W. reads into his words. He probably *is* assuming that the volumes of the solids of the same face (the equilateral triangle) inscribed in the *same* sphere are directly proportional to the number of faces, and therefore that the octahedron is exactly twice as voluminous as the tetrahedron in the *same* sphere and the icosahedron exactly two and a half times as voluminous as the octahedron. If this were true his equivalence-formulae would amount to the assertion that in every transformation of a 'particle' its volume remains constant, and I suspect this is at the bottom of the whole theory. This is not the assumption C. W. ascribes to him (since the face of the octahedron must be of less area than that of the tetrahedron and that of the icosahedron smaller still, if all three are inscribed in the same sphere). It would not be an unnatural assumption in the days before Theaetetus.

I believe that Timaeus is meant to fall into *this* error (which is quite consistent with supposing that he meant all along to allow variations in the size of the particle of each 'root'). We need not infer that Plato also made the same assumption. Theaetetus may well have known that it is not true, and Eudoxus certainly did, though the Academy in all probability may not yet have worked out the correct expressions for the volumes of the regular solids completely.[1] Since Euclid xii. 7 *Coroll.* gives the formula for the volume of a tetrahedron in terms of that of the prism of the same base and altitude, and xii. 8 *Coroll.* extends this to the case of a pyramid with any polygon for its base, it seems to me likely that *Plato* knew the correct expression for the ratio of the volume of the tetrahedron to that of the octahedron in the same sphere, and from the consideration that Apollonius's work dealt specially with the ratio of the volume of the dodecahedron to that of the icosahedron, it would look as if the problem had already been solved, presumably by Theaetetus and his Academic friends and successors, at any rate for all the solids *except* the dodecahedron. Solid geometry and astronomy are just the two branches of science about which it is most dangerous to assume that Plato knew no more than what he has thought fit to represent a fifth-century Pythagorean as knowing.

57 d 6. εἰκότι λόγῳ χρήσεσθαι. Note the reiterated emphasis laid at every fresh step on the 'provisional' and 'progressive' character of physical science. We shall never understand Plato's attitude to scientific research unless we bear in mind that this language represents one of his deepest convictions. It should also warn us against the error of supposing that Plato himself regarded as the 'most likely account' what had seemed to be such to men born sixty years before himself. Probably one of his reasons for making Timaeus dwell so often on the point that his

[1] Archimedes (*Ad Eratosthenem Methodus*, Works, ed. Heiberg ii. 430) expressly says that Eudoxus *proved* the formula for the pyramid ὧν Εὔδοξος ἐξηύρηκεν πρῶτος τὴν ἀπόδειξιν, περὶ τοῦ κώνου καὶ τῆς πυραμίδος, ὅτι τρίτον μέρος ὁ μὲν κῶνος τοῦ κυλίνδρου, ἡ δὲ πυραμὶς τοῦ πρίσματος, τῶν βάσιν ἐχόντων τὴν αὐτὴν καὶ ὕψος ἴσον. As Archimedes goes on to say that Democritus had enunciated the same propositions, though without proof (χωρὶς ἀποδείξεως ἀπεφήνατο), Timaeus may be a little antiquated in his solid geometry even for a fifth-century Pythagorean, and Plato may be deliberately keeping up historical verisimilitude by making him unaware of something a younger man would have known.

explanations are at best εἰκότες λόγοι was that with the further advances made in the knowledge of 'appearances' they had already ceased to be the 'most likely account' before the dialogue was written.

57 d 7—58 c 3. κινήσεως οὖν στάσεώς τε πέρι . . . παρέχεται. Timaeus now goes on to explain more fully exactly how that drifting off of the particles of each 'root' into a separate region which would ensue if 'random movement' were not counteracted by the laws of transformation, is prevented. We have learned that the geometrical structure which defeats the tendency was introduced by νοῦς for a definite *end*, viz. to prevent the destruction of an object which is καλόν, the οὐρανός; we still have to study the mechanism by which the end is effected. We begin by observing that motion presupposes heterogeneity, difference between the condition of different regions of nature. Motion would never arise in the purely homogeneous, because, as T. puts it, there are two parties to 'motion', the κινοῦν which sets it going, and the κινούμενον in which it is set going. Each party has its own role to play, and if everything were perfectly homogeneous there would not be this distinction between the roles of κινοῦν and κινούμενον, and therefore there could be no κίνησις. (As we are talking only about nature, the complex of σώματα, no question about the ψυχή, the 'motion which moves itself' arises. The κίνησις of which we are speaking is the 'ninth' kind of *Laws* x, that which 'moves something else but cannot move itself'.)

The point which Timaeus wants to make is a perfectly sound one. It is that already mentioned as fatal to attempts like that of Spencer to 'evolve' the world we know out of a pure homogeneity. You do not refute Timaeus by saying that we may presuppose motion, that we need not suppose our 'homogeneous' to be absolutely 'at rest'. The difficulty exists just as much if you start with absolutely uniform motion as your 'postulate'. If the condition of things were absolutely uniform every state of the world should be exactly like every other. Hence all things would appear to be at rest. You might, to be sure, speculate on the possibility that the whole scheme of things was moving uniformly, but as there would be no means of distinguishing such uniformity from absolute rest, the speculation would be unprofitable. The important thing in nature is that this is not the fact; there are *differential* motions and *differences* of level. This is what Spencer forgot in his *First Principles* when he set out to extract the universe from a homogeneous nebula. To get even one step on the way to the 'evolution' he had to invent the singular postulate which he calls the 'instability' of the homogeneous', i. e. to assume that a universe in which there are no differences at all invents differences for itself. (The reason why it is hard to keep any *observed* 'homogeneous' stable is precisely that it is not the whole of the universe; it 'does work' on what is outside itself and has 'work' done on it from without.) Timaeus takes the right line by *postulating* ἀνωμαλία, heterogeneity, differential motion, from the first. But we still have to explain how it comes about that the tendency to 'drift' does not sort out the particles into four separate layers in regions distinct from each other. If this did occur nothing more would happen in any of these layers, and γένεσις, the 'passage of nature' with time, its measure, would have come

to an end. Compare the guess of so many physicists of the last century that, owing to the dissipation of heat into space, the energy of the universe will finally be converted into heat diffused equally all through space. There would then be no more differences of energetic 'level', and the history of things would have come to an end and time along with it. 'The universe would have been killed by being 'stabilized' once for all when it became homogeneous in respect of the distribution of its energy. Timaeus, who has told us that γένεσις *always* goes on, has to explain why this collapse will never occur. He is thinking of the fact that Empedocles had supposed it to take place once in every cycle of the world's history, at the moment when 'Strife' has penetrated to the very centre of what was once 'the sphere', though it only lasts for an instant, because 'Love' at once begins to reassert itself (Empedocles Frs. 17, 27, 28, 30, 35 = R. P. 166, 167, 168, 169; *EGPh.*[3] 231–4, *Greek Philosophy, Thales to Plato* 71–5). But Empedocles' quasi-personification of φιλία and νεῖκος is no answer to the question how the 'sphere', once completely dissociated, is ever reformed again. As a substitute for physical theory it is on a level with Spencer's 'instability of the homogeneous'. Timaeus states his own theory as follows (58 a 5): 'When once the περίοδος of the whole has embraced the γένη—i. e. the particles of the 'roots'—being round and such as to tend to return into itself, it squeezes them all tight (σφίγγει), and permits no vacant room to be left.' A.-H. interprets this to mean that the revolution of the whole in the circle of the Same sets up a tremendous inward pressure, or 'constrictive force' which drives the different particles together. I do not see that this 'centripetal force' can really be got out of the text, and if it could it ought to create a grave difficulty for A.-H. For why should the revolution of the whole set up any such pressure as he supposes? If a man believes the theory, he ought to believe also that you can compress a liquid in a spherical vessel by rotating the vessel. And where in the whole history of ancient physical theories do we find any trace of such a 'constrictive force'? Nowhere, not even in Aristotle, who made more in his cosmology than any other theorist of the effects of the 'diurnal revolution'. The idea itself is, moreover, a false one. What rotation sets up is not 'centripetal' but 'centrifugal forces', and the old cosmologists, who depended for their notion of the way in which a κόσμος was formed by a δίνη on the analogy of eddies, were apparently aware of this, since the presence of the bigger bodies in the centre of the δίνη seems to have been explained simply as a consequence of their superior ability to retain their original motion. Anaxagoras, who explained the revolutions of the sun and moon on the analogy of stones swung round in a sling, was certainly alive to the facts (Aetii *Placita* ii. 13. 3, *Doxogr.* 341 = R. P. 157 c 'Α. τὸν περικείμενον αἰθέρα πύρινον μὲν εἶναι κατὰ τὴν οὐσίαν, τῇ δ' εὐτονίᾳ τῆς περιδινήσεως ἀναρπάσαντα πέτρους ἀπὸ τῆς γῆς καὶ καταφλέξαντα τούτους ἀστερωκέναι.) Perhaps A.-H. has it in his mind that the actual path of a particle will be the resultant of its tendency to 'drift' and the communicated 'circular revolution'. But clearly the resultant would not be a rectilinear motion inwards towards the centre, as the 'constrictive force' implies. The strongest argument against any such interpretation is

perhaps that it would, from the Greek point of view, amount to the suggestion that the 'heavens' have weight. This would be in Aristotle's eyes a heresy of the first magnitude, yet he never charges it on Timaeus, with whom he is very severe for much smaller departures from his own cosmology.

If we look carefully at the actual words of 58 a 5–7 we shall see that they make no reference to forces of pressure or centripetal forces. The *περίοδος* need not mean the 'revolution'; the literal sense is simply the 'way round', and thus 'circuit' is the natural rendering in English. *περίοδος* may just as well refer to circular form as to movement, just as *περίοδος τῶν τειχῶν* in Greek, or 'the circuit of the wall' in English, can stand either for the ring of the walls or for an excursion round it. So when we are told that God put the *περίοδοι* of the *ψυχή* in the head, the word only means 'circles'. Again *σφίγγειν* need not mean to compress; it can mean also merely to 'encompass round about'. In the very line of Empedocles quoted by A.-H. on this passage, *Τιτὰν ἠδ' αἰθὴρ σφίγγων περὶ κύκλον ἅπαντα*, the meaning is not that the air 'compresses' the earth, but merely that it 'clips it round'. Hence I take T. to be saying only that the 'round of the all' encompasses the particles of the 'roots', so that no space is left for them to 'drift' off to infinity in. It is the round shape and finitude of the all, not an imaginary centripetal force set up by the 'rotation', which 'leaves no space vacant'. M. understood this rightly, as appears from his version, which renders *περίοδος* by *contour* and *σφίγγει* by *reserre*, 'encloses'. Another difficulty in A.-H.'s view is that the only analogy on which Timaeus could have relied for the kind of result A.-H. extracts from him, that of the bulky body which makes its way to the centre of an eddy, ought to suggest that in process of time all the smallest particles, the tetrahedra of fire, would be forced to the outermost regions of the *οὐρανός*. We should then have to provide some counteracting 'force', of which Timaeus says nothing, to bring them back again. I thus take T. to mean simply that the *οὐρανός* being finite and round, the particles cannot get too far away from one another. We have also to remember what we have already been told, that the direction of 'drift' of any particle changes when it is broken up and reformed. This need not prevent disintegration of an infinitely extended *οὐρανός*; in a finite *οὐρανός* it does secure freedom from disintegration.

57 e 1–2. *τὰ μὲν οὖν . . . εἴρηται.* Cf. 37 c 6—38 b 5, 52 d 2—53 c 3, 57 c 1–6.

57 e 2–3. *ἐν μὲν ὁμαλότητι . . . ἐνεῖναι.* Cf. Parmenid. Fr. 8, 26–9 (*Fr. d. Vors.*[5] i. 156–7 = R. P. 118) *αὐτὰρ ἀκίνητον μεγάλων ἐν πείρασι δεσμῶν | ἔστιν ἄναρχον ἄπαυστον, ἐπεὶ γένεσις καὶ ὄλεθρος | τῆλε μάλ' ἐπλάχθησαν, ἀπῶσε δὲ πίστις ἀληθής. | ταὐτόν τ' ἐν ταὐτῷ τέ μένον καθ' ἑαυτό τε κεῖται.*

57 e 3–6. *τὸ γὰρ κινησόμενον . . . ἀδύνατον.* It is sometimes said that it was a standing prejudice of the Greek mind that all action implies an 'agent' and a 'patient', and that we have transcended the prejudice in learning to look on action as reciprocal. But it remains the fact that all 'work' depends on a difference of energetic 'level', and this is the real

truth expressed by the Greek language about agent and patient. This is all that Timaeus is assuming.

58 a 2. ἀνισότητος . . . διεληλύθαμεν. Cf. in particular 49 b–c, 52 a 4–7, 52 e 1—53 b 5.

58 a 7. κενὴν χώραν . . . λείπεσθαι. The words must not be pressed too literally. We hear of *διάκενα* immediately below in b 5 and other passages. I take it therefore that *οὐκ ἐᾷ* has an inceptive force ,' is not for leaving', ' makes against leaving'. Cf. the use of *οὐκ ἐῶ* in the sense of *dissuadeo*, ' I do not recommend you to do such and such a thing', Thucyd. i. 133 *καὶ περὶ τοῦ παρόντος οὐκ ἐῶντος ὀργίζεσθαι*, '*urging* him not to be indignant', '*trying* to appease his indignation', ii. 21 *οἱ μὲν κελεύοντες ἐπεξιέναι, οἱ δέ τινες οὐκ ἐῶντες*, ' some encouraging a sally, but a few *trying* to prevent it'. A.-H. says that ' Plato' does not deny the existence of *τὸ κενόν*, but only denies it 'as a mechanical principle'. If this means that Plato (i. e. Timaeus) does not ascribe agency of any kind to *τὸ κενόν*, it is only what might be said of all Greek thinkers. A.-H. adds that the volume of *κενόν* must be less than that of the smallest particle. Can this really mean that the whole of the ' unoccupied room' of the *κόσμος* is less voluminous than the smallest tetrahedron of fire? If so, there is not enough of it to be of use in accounting for any of the facts in connexion with which T. appeals to the existence of *κενά*. Of course there must be *κενά* for a very simple reason. Only two of T.'s corpuscles could fill up a space continuously, the cube and the tetrahedron (as A.-H. admits). And a *spherical* region cannot be completely filled up with rectilinear solids of any kind, unless you are prepared to suppose that there is an infinite range of different sizes of them from some finite magnitude down to the actually infinitesimal. Or is it meant that the volume of any *one* *διάκενον* is less than that of a particle of fire? Even this less extravagant assumption is not warranted by anything Timaeus says. The whole trouble about the apparent contradiction of the present passage with others which mention *διάκενα* arises from forgetting the inceptive force of *οὐκ ἐῶ*. All that is needed to prevent the cessation of *γένεσις* is that no set of particles should be able to drift indefinitely far from the neighbourhood of other sets of particles of a different shape. So long as this is prevented by the finitude and sphericity of the *οὐρανός*, encounters between different ' roots' and ensuing transformations and combinations will take place, and, as T. has already told us, when a ' drifting' particle has been transformed, the direction of ' drift' is changed. So no particle has a permanent tendency to drift in one and the same direction. (He returns to this important point and explains it more fully at 58 c 1.) The last remark, however, will not apply to the ' drifting' faces of a broken-up cube of earth, which cannot be transformed. Timaeus seems to forget that he has not explained why these might not all drift to some one region of the surface of his spherical *οὐρανός*. This seems to me a real oversight.

58 b 2–4. τὰ γὰρ ἐκ μεγίστων . . . ἐλαχίστην. But why should this be so? Why must icosahedra necessarily be closer set together than octahedra? Presumably T. is thinking of the particles as being in actual contact. If they are completely isolated, it is not clear why the statement should hold.

58 b 4. τῆς πιλήσεως. In the phrase *ἡ τῆς πιλήσεως σύνοδος* the genitive is 'definitory'; the *σύνοδος* consists in the *πίλησις*, they are virtually synonymous. Cf. *Laws* B. 657 b 4 *ἡ τῆς ἡδονῆς καὶ λύπης ζήτησις τοῦ καινῇ ζητεῖν ἀεὶ μουσικῇ χρῆσθαι* with Stallbaum's note *ad loc.* *Apology* 29 b 1 *ἀμαθία αὕτη ἡ ἐπονείδιστος ἡ τοῦ οἴεσθαι εἰδέναι ἃ οὐκ οἶδεν* (Madvig *Greek Syntax* [E. Tr.] § 49 a). *πίλησις* is the technical word, borrowed from the vocabulary of Anaximenes, for the process by which the 'denser' is produced from the 'rarer'. There is no implication of any 'force' of pressure. Rather the 'small' particles are thought of as having a proper motion of their own and getting into the 'interstices' between the 'larger' merely because they are there to be got into.

58 b 7. συγκρινόντων. Not 'compressing' but simply 'bringing together'. *σύγκρισις* is, in Greek scientific language, the standing antithesis to *διάκρισις*, 'separation', 'division', as here. The meaning is that the smaller particles are brought together, 'fused' with one another. E. g. when two particles of fire 'combine' to form one octahedron of air, there is no diminution of volume, according to the theory. As we have seen, T. probably means to say that the volume of the one octahedron is equal to that of two tetrahedra. What has happened is that where there were two particles of fire there is now one undivided particle of air. (In point of *fact* the volume of the one octahedron would be *greater* than that of the two tetrahedra if all three have the same edge.)

58 c 1–2. μεταβάλλον . . . στάσιν. This states a little more precisely what had been said at 57 c 1 *κατὰ ταῦτα τὰ παθήματα διαμείβεται τὰς χώρας ἅπαντα*. We have seen above that the provision for the endlessness of *γένεσις* requires this condition as well as that of the finitude of the *οὐρανός*.

58 c 2–4. οὕτω δὴ . . . παρέχεται. The words recall those of Aetii *Placita* i. 3, 3 from Theophrastus *Doxogr. Gr.* 277 = R. P. 16 a) *Ἀναξίμανδρος . . . φησι τῶν ὄντων τὴν ἀρχὴν εἶναι τὸ ἄπειρον . . . λέγει γοῦν διότι ἀπέραντόν ἐστιν, ἵνα μηδὲν ἐλλείπῃ ἡ γένεσις ἡ ὑφισταμένη*, where we can hardly doubt that the *ἵνα μηδὲν ἐλλείπῃ ἡ γένεσις* is an expression actually taken from Anaximander. Timaeus is probably echoing it intentionally. He also provides that 'becoming shall not fail', and does it *without* presupposing 'the boundless body'. His theory is in principle in close accord with Heraclitus's conception of 'exchange' regulated by strict measure, only that it is put into a definitely mathematical form, and that the bodies between which the exchange goes on are fire, air, water, not as with H. fire, water, earth. The main point of the theory, then, is that the finitude of the all and the shifts in the direction of 'drift' make it impossible that a Spencerian 'homogeneous' should exist. There must *always* be differences of level (we might think of differences of temperature, of 'potential' and the like) in different regions of the universe. Consequently, in modern phrase, 'work' will always be done, the 'entropy' of the system will *never* attain a final maximum, and so there will always be 'something going on'. What T. is really concerned to provide (though this way of putting it would not have been intelligible before the middle of the last century) is an arrangement for reversing what has been called the down-hill tendency of all 'energy', its tendency

to be dissipated off into uniformly diffused heat from which no further mechanical 'work' can be obtained. The necessity is really pressing for him because he regards the universe as in all respects finite. The nineteenth-century physicists who were troubled by the apparent impending fate of creation often forgot that all their prognostications depended on the assumption that the stock of energy available for 'work' is finite, and therefore, if the 'second law of thermodynamics' is true, exhaustible in a finite and theoretically calculable time. Hence Professor Ward rightly argued against them that on their own premisses they are not entitled to make any statement about the universe as a whole, and not therefore at liberty to assume that its 'total available energy' is finite (*Naturalism and Agnosticism*[1] i. 170–81). If, like Timaeus, they began by postulating the finitude of the universe, their argument would have been a valid one on the premisses (*a*) that the total 'energy' of the universe is finite, (*b*) that in every interaction between partial systems within the universe some of this energy is dissipated in the form of diffused heat, and cannot be reconverted into a form available for 'work'. If either premiss is false the conclusion does not follow.

We may now conveniently attempt a review of Aristotle's repeated and severe criticisms of the whole account of the ὑποδοχή and the geometrical construction of sensible bodies as given by Timaeus. This will give us an opportunity also to deal with the postponed difficulty about the 'drifting' of earth when its particles have been broken up into their constituent triangles.

(*a*) *Physics* Δ. 209^{b} 9—210^{a} 13. Here it is the conception of the ὑποδοχή itself which is under examination. Aristotle is discussing the difference between ὕλη, 'matter', and τόπος, 'place'. His own view is that, since *all* the Empedoclean roots are convertible—on this point he reverts to the old Ionian doctrines—and they are the simplest in structure of all actual 'terrestrial' bodies, all the rest being 'compounds' of them, they must have a common *substrate* (ὑποκείμενον), which, however, never actually exists except in the form of one or other of the four. This is what he calls 'primary matter' (πρώτη ὕλη) and regards as the permanent implied in all change. (The 'fifth body' of which the 'heavens' are made falls outside the scheme, since Aristotle held that no change ever takes place in the 'heavens', and they therefore require no 'substrate'.) He regards the account given by T. of the ὑποδοχή as due to a natural but illegitimate confusion. Since πρώτη ὕλη is the same in all the four 'roots', though it supports different 'qualities' in each, if you try to form the notion of it you have to think away the special 'qualities' of each 'root'. It is neither hot nor cold, neither moist nor dry. Thus it looks as though you were left with nothing but χώρα, 'room', a 'field'. This is how Timaeus proceeds (loc. cit. 209^{b} 9 ὅταν γὰρ ἀφαιρεθῇ τὸ πέρας καὶ τὰ πάθη τῆς σφαίρας, λείπεται οὐδὲν παρὰ τὴν ὕλην. διὸ καὶ Πλάτων τὴν ὕλην καὶ τὴν χώραν ταὐτό φησιν εἶναι ἐν τῷ Τιμαίῳ· τὸ γὰρ μεταληπτικὸν καὶ τὴν χώραν ἓν καὶ ταὐτό). A.'s own view is that what you have left behind, when you have thought away the pairs of 'opposite qualities' is not χώρα, the 'room' occupied by bodies, but their 'substrate', that in which their qualities 'inhere'. But this substrate is

sufficiently distinguished from χώρα by the fact that χώρα is not a substrate. The *place* (τόπος) of anything is just the inner surface of the body which immediately encloses it. Aristotle goes on directly after the words just quoted to say that Plato 'gives a different statement about the receptacle' in the dialogue from that of his unwritten doctrines (ἄλλον δὲ τρόπον ἐκεῖ τε λέγων τὸ μεταληπτικὸν καὶ ἐν τοῖς λεγομένοις ἀγράφοις δόγμασιν). (Simplicius says in commenting on these words that the reference is to the statement made in these unpublished lectures that the μεταληπτικόν is the Great-and-Small. It is important to observe that Aristotle was quite alive to the fact that what Timaeus is made to say and what Plato himself said in his own lectures are two things and not one.) But, he adds, at any rate both statements identify 'place' (τόπος) with χώρα, 'room'. He then proceeds to develop his own rival view that the 'place' of a thing cannot be identical with the 'substrate of events', because the 'place' of a thing is not, like its 'matter' or 'substrate', a constituent (μόριον) of the thing, but, so to say, a 'vessel' (ἀγγεῖον) enclosing it, so that you might call a vessel (pot, jar, bucket, &c.) a 'transferable place' (loc. cit. 209^b 29 ἔστι γὰρ τὸ ἀγγεῖον τόπος μεταφορητός). He then returns to Plato with the criticism, 'Plato ought to explain why his Forms and Numbers are not in a place, if place is that which receives them, whether this phrase stands for the Great-and-Small, or, as is written in the *Timaeus*, for matter' (loc. cit. 209^b 33, Πλάτωνι μέντοι λεκτέον, εἰ δεῖ παρεκβάντας εἰπεῖν, διὰ τί οὐκ ἐν τόπῳ τὰ εἴδη καὶ οἱ ἀριθμοί, εἴπερ τὸ μεθεκτικὸν ὁ τόπος, εἴτε τοῦ μεγάλου καὶ τοῦ μικροῦ ὄντος τοῦ μεθεκτικοῦ, εἴτε τῆς ὕλης, ὥσπερ ἐν τῷ Τιμαίῳ γέγραφεν. Of course the reference to τὸ μεθεκτικόν as described in the *Timaeus* is to the use of words like δέχεσθαι, ὑποδοχή, δεξαμενή).

As a criticism of the *Timaeus* this has the fault of so many of Aristotle's criticisms. He could not think readily except in terms of his own system and so his statements of an earlier thinker's problem are usually unhistorical. There is a certain analogy between χώρα as described by Timaeus and Aristotle's own concept of πρώτη ὕλη, since both are meant to provide a permanent background for change. But it is not true that Timaeus *confuses* ὕλη with χώρα. The real fact is that ὕλη plays no part in his analysis. He requires, in addition to the Forms, only two further concepts, that of sense-data or 'events' (αἰσθητά) and that of extension. He never introduces the idea that 'events' inhere in any kind of substratum any more than Berkeley does. The really pertinent criticism from the Aristotelian point of view is not that Timaeus makes τόπος or χώρα the substrate of αἰσθητά, but that he does not provide any substrate for them whatever. The fact is that Aristotle is wedded to a form of the 'bifurcation of nature'. He does not believe, like Galileo or Descartes, in that version which makes αἰσθητά 'secondary effects in our minds', but he does hold a simpler version depending on the logical theory that all propositions are in the last instance 'predications', attributions of an *attribute* to a *subject*. The 'qualities' which are 'predicated' are supposed to 'inhere in' and depend on the logical subject of which they are predicated. 'First matter' is simply the 'subject of predication' transferred from logic to physics, as is indicated by the fact that the same name which is

used in logic for this subject (τὸ ὑποκείμενον, that which is *subiectum praedicationi*) reappears in physics as the name for the 'substrate'. If one rejects this form of distinction between nature as subject and nature as predicate, and possibly also the logical analysis of the proposition on which it is founded, one will recognize it as a great merit in Timaeus that 'matter' in the sense of Aristotle, or of the modern physicists whom Whitehead calls 'materialists', has no place in his system. If one believes Aristotle's logical doctrine, on the other hand, it seems necessary to accept his version of the bifurcation of nature, and to hold that his comments reveal a fatal flaw in T.'s *Naturphilosophie*, the absence of a 'substrate', though, in any case, Aristotle's way of expressing the criticism is not historically correct.

The remark about the Forms and Numbers, which Aristotle himself calls a 'digression', is not a serious criticism. It is only a verbal 'score' for which Aristotle himself half apologizes, in fact, a quibble over the fact that Plato sometimes talks of things as 'receiving' Forms, but also makes Timaeus speak of χώρα as 'reeciving' αἰσθητά. Aristotle, no doubt, knew well enough that the relation expressed by the word is very different in the two cases.

(*b*) There is a long polemic against the construction of the particles out of the elementary triangles in *de Caelo* Γ. 305^{b} 28—307^{b} 24. Aristotle makes fifteen objections in all, but they are by no means all of equal value. As Simplicius says, in commenting on them, some of them are no better than σκώμματα, 'japes'. Others are of a much more serious character. Proclus found it worth while to write a work expressly in refutation of these criticisms. The work has disappeared, but Simplicius, commenting on this section of the *de Caelo*, has preserved an epitome of it which shows that it met Aristotle's points with acumen and good sense. Naturally the argument on which most stress is laid by Aristotle is the appeal to common-sense on the attempt to manufacture physical bodies out of purely geometrical plane figures. I propose to recapitulate the objections as briefly as I can.

Aristotle begins with the general observation that if the four ἁπλᾶ σώματα or some of them can be converted into one another by μετασχηματίσις, 'change of form', as 'some' say, this implies that there are 'atoms', indivisible bodies (loc. cit. 305^{b} 32 συμβαίνει ἐξ ἀνάγκης ἄτομα λέγειν τὰ σώματα), because otherwise 'the parts of fire will not be fire, nor those of earth earth, since any and every part of a pyramid is not itself a pyramid, nor is any and every part of a cube itself a cube'. Strictly speaking, this general observation does not affect the position of Timaeus, for his language definitely means that each of his corpuscles can be broken up only by resolving it into its plane faces, and in what he says e. g. about the debris of 'broken' cubes of earth 'drifting' until they reunite with others and 'become earth again' (56 d 5) he expressly accepts the very consequence which Aristotle is treating as a difficulty, viz. that the 'parts' of a particle of earth, water, &c., are not themselves earth or water, &c. Aristotle's objection is based simply on his own adhesion to the theory that each of the ἁπλᾶ σώματα can be subdivided indefinitely into parts of the same specific character as the whole. T.'s view is that the *only*

parts into which a particle of a 'root' can be divided are in character quite disparate from the particle itself. Now come the fifteen objections in detail.

I. Earth ought not to be exempted from the general law of transformability because (*a*) it is not 'plausible' that there should be an exception (loc. cit. 306ª 3 *οὔτε γὰρ εὔλογον ἓν μόνον ἄμοιρον γενέσθαι τῆς μεταβάσεως*), and (*b*) because our senses reveal cases of the transformation in question (ib. 4 *οὔτε φαίνεται κατὰ τὴν αἴσθησιν, ἀλλ' ὁμοίως πάντα μεταβάλλειν εἰς ἄλληλα*). The obvious reply is that as to the evidence of our senses, Aristotle's statement rests on a misinterpretation, and as to 'plausibility', if experience really *does* provide examples of the transformation of the other 'roots' but none of the transformation of earth, it is a 'plausible' view that a particle of earth has a geometrical structure radically different from those of the other three bodies. Aristotle adds the remark that such theories are only put forward by persons who wrest the sense-experiences on which we ought to found our physical theories into accord with pet preconceptions of their own (loc. cit. 306ª 7 *τούτου δ' αἴτιον τὸ μὴ καλῶς λαβεῖν τὰς πρώτας ἀρχάς, ἀλλὰ πάντα βούλεσθαι πρός τινας δόξας ὡρισμένας ἀνάγειν κτλ.*). From the author of the *Physics* this stricture is unconsciously humorous.

II. On the theory 'earth' would be the *only* real *στοιχεῖον* because it is the only one which never passes into anything else (loc. cit. 306ª 17 *συμβαίνει δ' αὐτοῖς μάλιστα τὴν γῆν εἶναι στοιχεῖον καὶ μόνην ἄφθαρτον . . . ἡ γὰρ γῆ μόνη ἀδιάλυτος εἰς ἄλλο σῶμα*). This again is no valid objection to T.'s hypothesis, if that hypothesis really 'saves the appearances'. It is a mere expression of Aristotle's prejudice in favour of regarding the four *ἁπλᾶ σώματα* as all on a level.[1]

III. The drifting about of 'suspended' triangles, when a particle has been broken up, i.e. the drifting about of mathematical surfaces which have no thickness, is not a reasonable supposition (loc. cit. 306ª 20 *ἀλλὰ μὴν οὐδ' ἐν τοῖς διαλυομένοις ἡ τῶν τριγώνων παραιώρησις εὔλογος*).

IV. The theory assumes *bodies* to be made out of planes, but this is impossible (loc. cit. 306ª 23 *ἔτι δ' ἀνάγκη τοῖς ταῦτα λέγουσιν οὐκ ἐκ σώματος ποιεῖν γένεσιν· ὅταν γὰρ ἐξ ἐπιπέδων γένηται, οὐκ ἐκ σώματος ἔσται γεγονός*).

V. It contradicts the principle that all bodies are divisible *ad indefinitum* into lesser bodies (loc. cit. 306ª 26 *ἀνάγκη μὴ πᾶν σῶμα λέγειν διαιρετόν*). This is really a return to the initial point already urged before the fifteen arguments are rehearsed. Ar. says that the theory is at variance with the 'most exact sciences', by which he means geometry. For in geometry even purely mathematical figures are always divisible, but on T.'s theory a tetrahedron of fire, which is actually an *αἰσθητόν*, cannot be divided as we please into parts. So that a subdivision of fire will not be fire, and so 'there will be something prior to the *στοιχεῖον*', or else you must say, as you will if you treat the tetrahedron of fire as a *στοιχεῖον*, that there is a limit to the divisibility of a body (loc. cit. 306ª 34 *ὥστε ἢ τοῦ πυρὸς μέρος οὐ πῦρ, ἀλλ' ἔσται τι πρότερον τοῦ στοιχείου . . . ἢ οὐχ ἅπαν σῶμα διαιρετόν*). Timaeus is not really affected by this dilemma.

[1] It seems to be forgotten that Timaeus does not regard earth or any other 'root' as a *στοιχεῖον* any more than Aristotle did. His *στοιχεῖα* are the elementary triangles.

'Fire' is not a στοιχεῖον on his theory; as he has said, it is not even a 'syllable'. His στοιχεῖα are the two primitive triangles, so that his view that 'not every part of fire is fire' does not involve the consequence that there is something more primitive than *his* στοιχεῖον. As to the other 'horn' of the dilemma, T.'s view is not that a tetrahedron cannot mathematically be divided into lesser volumes, but that *physically* it can only be broken up into its triangular faces. Ar.'s argument simply confuses an hypothesis about physical fact with a mathematical analysis.

VI. There is a more fundamental objection still to the view that the ἁπλᾶ σώματα have the shapes of the regular solids. If they have, the universe cannot be continuously filled with them. There are only two of them which can fill up a space without leaving interstices, the cube and the pyramid. But as there are four ἁπλᾶ σώματα, it follows that the particles of two of them at least must leave empty interstices (loc. cit. 306^b 4–9). Here it is forgotten that Timaeus actually speaks of the διάκενα between particles more than once. Aristotle is assuming the truth of his own theory that there is no such thing as space unoccupied by body. As usual, he shows himself quite incapable of examining a rival theory simply on its merits as 'saving the appearances'. This tacit assumption that his own hypothesis is admittedly the truth makes him one of the most unsympathetic of all philosophical critics of other men. He *never* succeeds in fairly seeing what any one else's theory has to say for itself.

VII. Further, none of the ἁπλᾶ σώματα is a rigid body with a definite shape of its own. All of them take the shape of the 'place' which contains them, as we see in the case of water and air (i. e. he assumes that they are all perfect fluids). 'So it is impossible that the shape of an elementary body should remain unchanged (loc. cit. 306^b 11 διαμένειν μὲν οὖν τὸ τοῦ στοιχείου σχῆμα ἀδύνατον); if it did, the whole would not be everywhere in contact with that which contains it (οὐ γὰρ ἂν ἥπτετο πανταχῇ τοῦ περιέχοντος τὸ ὅλον). But if it should change its shape, it would no longer be water, on the theory that a geometrical shape is the differentia of water (εἴπερ τῷ σχήματι διέφερεν, 306^b 14). So manifestly their shapes are not definite.'

VIII. It is next argued that flesh, bone, or other continuous bodies (ὁτιοῦν σῶμα τῶν συνεχῶν, 306^b 23) cannot be formed, as T. maintains that they are, out of his corpuscles. For the corpuscles do not fill up space continuously. (Only cubes and pyramids do this, and on T.'s own physiological theory flesh and bone are not composed exclusively of earth and fire but of all four 'roots'.) Nor can these bodies be *directly* formed from the plane faces, for Timaeus himself supposes only 'elementary bodies', the particles of the 'roots', not the chemical compounds of the 'roots', to be constructed directly from his 'triangles' (τὰ γὰρ στοιχεῖα γεννᾶται τῇ συνθέσει καὶ οὐ τὰ ἐκ τῶν στοιχείων, 306^b 25).

IX. Also the particular shapes T. assigns to each class of particles are not the most appropriate. Some, i. e. Democritus, had said that, since fire is the most mobile of things, its atoms are spherical. Others (he means Timaeus) said, for a similar reason, that its particles are pyramids. But these are not appropriate shapes for the particles of fire. The

'proper movement' of fire is vertically 'up', and there is nothing in the spherical or pyramidal shape to make it specially adapted for this particular movement (*εἰ γὰρ καὶ ἔστιν εὐκινητότατα ταῦτα τῶν σχημάτων, ἀλλ' οὐ τὴν τοῦ πυρὸς κίνησιν εὐκίνητα· ἡ μὲν γὰρ τοῦ πυρὸς ἄνω καὶ κατ' εὐθεῖαν, ταῦτα δ' εὐκίνητα κύκλῳ*, 307ᵃ 4–7). So T. makes the particles of earth cubes because earth is hard to dislodge. But earth is only hard to dislodge 'in its own region' (307ᵃ 9 *μένει δ' οὐ πανταχοῦ ἀλλ' ἐν τῷ αὑτῆς τόπῳ*), and when out of its own 'region' it falls down unless it is checked in its descent. Fire or any other 'element' is equally hard to dislodge from its own 'region'. So that at this rate every 'element' should have cubical particles in its own region, but they should change their shape as soon as they get out of that region (loc. cit. 307ᵃ 11 *δῆλον ὅτι καὶ τὸ πῦρ καὶ ἕκαστον τῶν στοιχείων ἐν μὲν τῷ ἀλλοτρίῳ τόπῳ σφαῖρα ἔσται ἢ πυραμίς, ἐν δὲ τῷ οἰκείῳ κύβος*). The force of the argument depends entirely on the assumption of Aristotle's own fantastic explanation of the *descensus gravium* by the theory of an absolute 'up' and 'down' and a corresponding absolute 'gravity' and 'levity'. He does not mention that Timaeus wholly denies the reality of an absolute 'up' and 'down' and gives a different explanation of the facts about gravity.

X. If T. is right in saying that the reason why fire burns is that it cuts into things in virtue of the sharpness of its angles, all the 'elements' ought to be *θερμαντικά*, productive of heat, though in varying degrees, since all T.'s regular solids have angles. But this is manifestly not the case (307ᵃ 18 *διοίσει τῷ μᾶλλον καὶ ἧττον· τοῦτο δ' ὅτι ἔστι ψεῦδος, φανερόν*).

XI. Besides it ought to follow that purely geometrical figures can diffuse heat and cause burns, for they have angles (307ᵃ 19 *ἅμα δὲ συμβήσεται καὶ τὰ μαθηματικὰ σώματα καίειν καὶ θερμαίνειν· ἔχει γὰρ κἀκεῖνα γωνίας*).

XII. 'If a thing which is burning is being converted into fire (*πυροῦται*, cf. *Tim.* 51 b 4 *πῦρ μὲν ἑκάστοτε αὐτοῦ τὸ πεπυρωμένον μέρος φαίνεσθαι*), and fire is made of pyramids, then everything which is set on fire will be turned into pyramids. But to say that one pyramid makes other things into pyramids is like saying that a knife divides e. g. a loaf into knives or a saw billets of wood into saws (307ᵃ 28 *τὸ δ' ἐξ ἀνάγκης τὴν πυραμίδα ποιεῖν πυραμίδας ἢ τὴν σφαῖραν σφαίρας παντελῶς ἄλογον καὶ ὅμοιον ὥσπερ εἴ τις ἀξιοίη τὴν μάχαιραν εἰς μαχαίρας διαιρεῖν ἢ τὸν πρίονα εἰς πρίονας*). Simplicius calls the last two criticisms *σκώμματα*, 'chaff', and for the credit of Aristotle's common sense it is to be hoped they were meant for nothing more.

XIII. T. regards it as the special work of fire to break up and divide things, and for that reason gives its particles sharp angles. But fire coagulates as well as divides. It dissipates what is heterogeneous but brings together what is homogeneous, and Aristotle *asserts*, without giving any reason, that the coagulating belongs to fire *per se*, the dividing only *per accidens* (loc. cit. 307ᵇ 1 *ἡ μὲν σύγκρισις καθ' αὑτό ἐστι . . . ἡ δὲ διάκρισις κατὰ συμβεβηκός*).

XIV. If the 'hot' (i. e. fire) has particles of a definite shape, its opposite, the 'cold', ought to have particles of an opposite shape. But

no shape is the 'opposite' of any other shape. Hence T. has not provided any special particle for the 'cold'. But *προσῆκεν ἢ πάντα ἀφορίσαι σχήμασιν ἢ μηδέν* (307^{b} 9). This is really a superficial cavil at the very possibility of a mathematical physics.

XV. Some persons explain cold by saying that what has large parts is cold because it contracts the 'pores' of the body and cannot pass through them (an allusion to the account of cold in *Tim.* 62 a–b). But this is to make the difference between hot and cold depend not on the shape but on the size of the particles. At that rate, if all pyramidal particles are not of the same size (and Timaeus holds that they are not, 58 c 5) the larger ones will not be fire and their shape will be the cause not of burning but of its opposite (*εἰ ἄνισοι αἱ πυραμίδες, αἱ μεγάλαι ἂν εἶεν οὐ πῦρ οὐδ' αἴτιον τὸ σχῆμα τοῦ καίειν, ἀλλὰ τοῦ ἐναντίου*, 307^{b} 16).

This is Aristotle's chief attack on the theory of body given in the *Timaeus*, but he returns to the charge more briefly elsewhere.

(*c*) *de Generatione* A. 315^{b} 30 ff. he again mentions the construction of bodies in the *Timaeus* out of planes and says that he has examined it and shown its absurdity elsewhere, i. e. in the long passage of the *de Caelo* just summarized (*τοῦτο μὲν οὖν αὐτό, καθάπερ καὶ ἐν ἄλλοις εἰρήκαμεν, ἄλογον μέχρι ἐπιπέδων διαλῦσαι*). He winds up with a slap at Plato's fondness for mathematics, remarking that 'those who have been more at home in physics are more competent to make hypotheses about the composition of bodies; those who, by reason of their many discourses, have never made a survey of the real facts put forward rash speculations on the strength of a slender basis in facts' (316^{a} 6 *ὅσοι ἐνῳκήκασι μᾶλλον ἐν τοῖς φυσικοῖς μᾶλλον δύνανται ὑποτίθεσθαι τοιαύτας ἀρχὰς αἳ ἐπὶ πολὺ δύνανται συνείρειν. οἱ δ' ἐκ τῶν πολλῶν λόγων ἀθεώρητοι τῶν ὑπαρχόντων ὄντες, πρὸς ὀλίγα βλέψαντες, ἀποφαίνονται ῥᾳον*).

(*d*) *de Generatione* B. 329^{a} 14 contains another attack on the account of the *ὑποδοχή*. Aristotle complains that in the passage where T. uses the illustration of the man who is beating or rolling the gold into all sorts of shapes, the *ὑποδοχή* is treated as a substrate of the 'so-called elementary bodies'. But the analogy is not a sound one. It is impossible to give to things which begin to be and perish again the name of that 'out of which' they arise. Yet Timaeus says it would be far the truest way of speaking to call each of the figures made by the man who is rolling the gold *gold*. (He means that if T. is in earnest with his analogy, he ought to call all bodies space. But the analogy does not really hold, because space is not the *substrate* of the things which appear in and vanish from it.) The passage has already been quoted and examined in the notes on 50 a–b *supra*. Aristotle adds a comment on the mathematical construction of the *ἁπλᾶ σώματα*. The *στοιχεῖα* are solid bodies, and T. analyses them into planes. But it is impossible that his planes should be the 'nurse' i. e. 'primary matter' (loc. cit. 329^{a} 21 *ἀλλὰ τῶν στοιχείων ὄντων στερεῶν μέχρι ἐπιπέδων ποιεῖται τὴν ἀνάλυσιν· ἀδύνατον δὲ τὴν τιθήνην καὶ τὴν ὕλην τὴν πρώτην τὰ ἐπίπεδα εἶναι*). There seems here to be a curious inability to grasp T.'s thought. For it is not the *τιθήνη* but the 'offspring', the *γιγνόμενον*, which Timaeus has 'analysed into planes'. The *ὑποδοχή* itself was expressly declared to be *ἄμορφον*.

These criticisms cannot be said to give us a high estimate of Aristotle's capacity. Some of them seem to be poor pleasantries; others deal with points of detail which do not affect the merits of the general theory. Others rest on sheer misinterpretation of actual facts or presuppose the truth of fancies to which Aristotle was personally addicted. The impression they leave on me is the same which I get from Aristotle's physics and cosmology as a whole, that of all the considerable Greek philosophers Aristotle was far the most incompetent as a physicist. His theories are less scientific in spirit than the first speculations of Anaximander and immeasurably less so than the beautiful and brilliant theory of matter thought out by Anaxagoras. What his polemic does prove is the extraordinary difficulty he had in understanding the point of view of mathematical physics, which Plato represents as perfectly familiar to Timaeus. It seems to him simply unintelligible that any one should attempt to explain the course of natural events by the geometrical structure of particles. This mathematical incompetence is what has unfortunately made the very works on which Aristotle lavished most pains, the *Physics*, *de Caelo*, *de Generatione*, a curse to science.

If we neglect those objections which are either trivial or concerned with minor details or based on groundless prejudice, the principal points which are left of the whole polemic are two:

(1) There is the difficulty about the 'drifting' surfaces with no thickness. This is real enough. Surfaces, it is urged, have no being except as the boundaries of volumes, and it is three-dimensional bodies, not surfaces, which move. But we must not forget that the very source of the 'antinomies' which Zeno detected in the Pythagorean mathematics was precisely the conception of the point, the ultimate unit of all extension, as a minimal *volume*. It is thus probable that a Timaeus would have seen nothing absurd in the conception of a drifting surface. Again, the conception of the drifting surfaces is, after all, only a perplexing way of describing certain real facts. We too can and do think of a *geometrical configuration* as moving when we speak of the 'propagation' of wave-motion, e. g. when we talk of a wave as passing from end to end of a sheet of water. It is the *form* of the undulation, not a body of stuff, such as a set of drops of water, which we say passes from one end to the other of the sheet. It is easy to understand how the attempt to describe the real fact which we call the propagation of the wave, i. e. the continuous passage of one and the same surface-configuration across the whole sheet might be talked of by a Timaeus as the drifting of a mathematical surface, and from this to the drifting of the faces of the dissociated cube or the tetrahedron which has not yet been reformed is a very easy step.

I may just refer to a striking parallel with part at least of T.'s conception provided by Professor Whitehead's account of 'vagrant areas' (*Concept of Nature* p. 103).

(2) Then there is the argument, which appeals strongly to 'common-sense', that solid bodies cannot be made of planes. To a large extent the apparent conclusiveness of this argument depends on the 'materialism', in Whitehead's sense, of Aristotle and 'common-sense'. The 'nerve'

of the reasoning is the assumption that a body must have a 'substrate'. From the point of view of those who reject the 'bifurcation' of nature, it is easy to reply that Timaeus does not make bodies out of 'empty space', as the Aristotelian argument supposes him to do. He makes them out of χώρα *plus* αἰσθητά ('events', in Whitehead's terminology). The surfaces of his particles are not empty space in the sense of being places where nothing is going on. All sensible events (the appearances of colour, warmth, coldness, &c.) go on precisely at these places. Nor are the surfaces really thin shells with a finite but very small thickness. They are true mathematical surfaces, but they are also the places at which sensible events go on. In that sense the particles are not made of χώρα. But if you argue that bodies cannot exist unless, over and above surfaces at which sensible events are going on, there is also an 'imperceptible substrate' like Aristotle's πρώτη ὕλη, any one who is not committed by his logical theory of propositions to 'bifurcation' may fairly retort that he does not see the necessity. Given events and space-time and the universals or 'objects' which are 'ingredient in' the events (the Forms or παραδείγματα of Timaeus), you have all that is needed for a physical world, and even for the distinction between 'occupied' space and 'empty' space, in the only sense in which science requires such a distinction; the introduction of 'matter' as a substrate for events is a useless complication. (Cf. the excellent chapter 'Matter' in *Grammar of Science*[3] Pt. I. 266–303, though Professor Pearson unnecessarily weakens his case by the superfluous assumption of a crude 'phenomenalist' metaphysics.) The argument about the impossibility of filling space continuously with any particles except cubes and 'pyramids' should not impress us seriously. It has weight with Aristotle merely because he has convinced himself that there can be no 'empty' space. But all the metaphysical arguments against a *vacuum* rest on an equivocation. If an 'empty' space means a region where nothing at all is going on, every one who admits that extension is a character of *events* must agree with you that there is no such thing. But if you only mean by 'empty' space what a physicist means when he talks of an 'empty' electro-magnetic field round an electron, then there is no reason to make any difficulty about the matter. No assumption could be more arbitrary than the assumption that where our senses detect nothing there *is* nothing going on. The admission that events are going on where our senses cannot detect them in no way justifies the inference that these events require a 'material substrate'. And it is peculiarly unreasonable to fall foul of a Pythagorean, a member of the school which more than any other asserted the reality of τὸ κενόν, for making use of one of the best-known doctrines of his school. The real lesson of Aristotle's inability to make anything of the theory of Timaeus is that it is very hard for a biologist to understand the thought of a logician or mathematician, and that biologists' pronouncements on questions about the ultimate presuppositions of knowledge require to be scrutinized with the utmost caution, precisely because their own study has as yet attained so little ἀκρίβεια as to be rather what Plato calls the εἰκὼς λόγος than what he means by ἐπιστήμη.

We come now to detailed attempts to give an account of the different kinds of bodies actually found to exist. We pass from kinematics and mechanics to descriptive physics, physiology, and psychophysiology. First Timaeus tries to specify the principal varieties of fire, air, water, earth, corresponding to the different sizes of the elementary triangles. Then he goes on to the chemical compounds, as we should call them, of the 'roots', paying particular attention to those which enter into the bodies of living organisms. This leads him from descriptive physics into anatomy and physiology and so to a great deal of physiological psychology about the structure and working of the organs of sense. Finally he gives us a general medical theory of the origin and symptoms of bodily and mental disease, and a pathological psychology of appetite and emotion (58 c 5—87 b 9). Here for the most part the immediate background of his discourse ceases to be geometry and becomes Empedoclean biology and Sicilian medicine. Much of what he says is hard to interpret in the imperfect state of our information about the biology and medicine of the fifth century, and as the details have, for a great part, no special philosophical significance, and would require for their full elucidation a mass of geological, biological, and medical knowledge which I do not possess, I shall be content to pass very lightly over a great deal in the exposition, though I shall do all I can to indicate what I take to be the best accredited text in doubtful places, to discuss the verbal exegesis of all difficult phrases, and to indicate all signs of connexion between the doctrines of Timaeus and the known theories of fifth-century science. On the relation of T.'s theories to those current in later Greek philosophy and science I shall not dwell except to compare them carefully with the views of Aristotle. For fuller information I must refer to the amazing and accurate erudition of the notes on this part of the dialogue in Martin's *Études*.

58 c 5–d 4. μετὰ δὴ ταῦτα . . . ἀνισότητα. The sub-varieties of fire and air. Of fire T. distinguishes three chief varieties (though he is careful to say that there are many others, (*γένη πολλά*), (1) *φλόξ*, flame, (2) light, which he regards as an emanation from flame, which does not 'burn' (*τὸ ἀπὸ τῆς φλογὸς ἀπιόν, ὃ κάει μὲν οὔ, φῶς δὲ τοῖς ὄμμασιν παρέχει*), (3) the red glow left behind in embers and red-hot bodies generally. The one point to be noted is that, like all the early *φυσικοί*, he regards light as a kind of body, just as they all regarded fire as a special kind of body. This has the advantage that it enables T. to regard stars and planets, as the early physicists in general did, as things of the same kind as the terrestrial bodies which emit flame or glow. Aristotle makes it a special point that light is *not* a body. To admit that light is a body emitted from fires would upset his whole theory that the 'celestial' matter of the sun and stars is wholly different from the 'elementary matter' of which terrestrial bodies are made. Hence he holds, as the middle ages did after him, that the heavens and the light-giving bodies they contain are not themselves 'hot' or 'bright', i. e. are not incandescent; light and heat are merely effects they produce on us and our 'terrestrial' surroundings. For this reason Aristotle rejects the happy divination of Empedocles that light requires time for its transmission (*de Anima* B. 418^{b} 20 *καὶ οὐκ*

ὀρθῶς Ἐμπεδοκλῆς οὐδ' εἴ τις ἄλλος οὕτως εἴρηκεν—perhaps an allusion to the *Timaeus*—ὡς φερομένου τοῦ φωτὸς καὶ τεινομένου ποτὲ μεταξὺ τῆς γῆς καὶ τοῦ περιέχοντος, ἡμᾶς δὲ λανθάνοντος). His own view is that light is the 'agitation in a certain way' of a transparent medium such as air or water (ib. 418^{b} 9–10 φῶς δέ ἐστιν ἡ τούτου ἐνέργεια, τοῦ διαφανοῦς ᾗ διαφανές), the 'activity of the transparent as such'. At first sight this looks like an approximation to the undulatory as against the 'corpuscular' theory of light, but it is not really so. Our theory requires the undulations to be propagated from a luminous body as a centre, and this body is incandescent and the propagation requires time. Also the propagation of light in *vacuo* is an indispensable part of the theory, unless we arbitrarily deny this and then invent an imaginary 'ether' to undo the consequences of our denial. There is thus no important resemblance between our undulatory or electro-magnetic theories about light and that of Aristotle which all through the middle ages led men to hold that if you could get to the sun you would find neither heat nor light there. Again, it seems now to be well established that light has mass and that its path is deflected in the neighbourhood of a body of great mass like the sun (Eddington *Space Time and Gravitation* c. vii. 110–22). Thus there is really at least as much approximation to modern theories in a view like that of Timaeus as in the Aristotelian doctrine, while the acceptance of the latter with its corollaries was one of the greatest hindrances to the development of a correct view of the nature of the heavenly bodies at the great revival of science. I do not stay here to speak of the influence of the denial that light is properly a body on theology, which lies e. g. at the bottom of Milton's language about the 'Bright effluence of bright essence uncreate' (*P. L.* iii. 6), and the speculations of the Eastern Church about the 'uncreated' light.

Note that the ἀπιών of 58 c 6 is another example of a true reading preserved by F against A W and Y. Before the collation of F the true reading had to be 'restored' from Galen.

58 d 1–4. κατὰ ταὐτὰ . . . ἀνισότητα. 'Air' again has three kinds with names of their own, and many intermediate unnamed varieties. The 'brightest' or clearest' is αἰθήρ, a word which properly means in poetry the bright blue of the unclouded sky, the 'Vault of blue Italian Day' of Shelley, the second or less clear, not actually named by Timaeus, but implied by the mention of the εὐαγέστατος and the θολερώτατος, is our common 'atmosphere', the third and 'mirkiest' is mist (ὁμίχλη) or darkness (σκότος). Note that αἰθήρ is a word actually used by Empedocles when he wishes to name 'air' as one of his four 'roots', though later writers always speak of ἀήρ in this connexion, exactly as Timaeus himself does. ἀήρ or ἠήρ is sometimes used in this sense by Empedocles (Fr. 17. 18 = R. P. 166 πῦρ καὶ ὕδωρ καὶ γαῖα καὶ ἠέρος ἄπλετον ὕψος, contrast Fr. 109 = R. P. 176 γαίῃ μὲν γὰρ γαῖαν ὀπώπαμεν, ὕδατι δ' ὕδωρ, | αἰθέρι δ' αἰθέρα δῖον, ἀτὰρ πυρὶ πῦρ ἀίδηλον). Anaxagoras, on the other hand, equally naturally uses αἰθήρ to mean 'fire' when he says in Fr. 1 (R. P. 151) that ἀήρ and αἰθήρ were the principal components of the original 'mixture' before νοῦς began the work of separation (πάντα γὰρ ἀήρ τε καὶ αἰθὴρ κατεῖχεν. Cf. Aristotle's remark on A.'s terminology, *de*

Caelo Γ. 302^{b} 4 τὸ γὰρ πῦρ καὶ τὸν αἰθέρα προσαγορεύει ταὐτό). In the view that our 'atmosphere' and further 'mist and darkness' are more 'turbid' forms of ἀήρ Timaeus is following the old Milesian view of Anaximenes, which had really been disposed of by the two discoveries, both recorded by Empedocles, that atmospheric air is an invisible body and that night is not a mist rising from the earth but the shadow of the earth itself (Fr. 48 νύκτα δὲ γαῖα τίθησι ὑφισταμένοιο φάεσσι). Timaeus had recognized the truth of the newer doctrine at 40 c 1–2, but it is not surprising that we should find traces of the old belief that cloud, mist, darkness are condensed ἀήρ still inconsistently colouring some of his language. The ἀνώνυμα εἴδη will be intermediates between the better defined varieties which have received distinct names. The theory, no doubt, is that the triangles of the octahedra of αἰθήρ are the smallest, those of the octahedra of σκότος and ὁμίχλη the largest.

58 d 4—60 b 5. τὰ δὲ ὕδατος . . . ἐπωνομάσθη. The kinds of water. These are more numerous and include a great variety of important bodies. Hence they have to be dealt with much more fully. We begin by a distinction of two main kinds, the *liquid* (ὑγρόν) and the fusible (χυτόν). The former turn out to mean ordinary liquids, the latter metals, which T. regards as liquids that have a very high 'freezing-point' and are therefore found in the solid state at all temperatures which are common at the earth's surface. It may seem strange that metals should be regarded as forms of water, but the strangeness will disappear if we remember (*a*) that T. regards water as the common basis of all liquids and (*b*) that his point is the correct one that with a sufficiently high temperature all metals liquefy. The classification of metals as liquids may therefore remind us that the view has often been expressed in our own day that hydrogen, which we only know in nature as a 'gas', is really the 'vapour' of a metal. Again, mercury is a metal and we find no difficulty in thinking of it as one, but mercury is liquid at most temperatures with which we are familiar. It is only in the most exceptional low temperatures that the mercury in the thermometer freezes. The classification thus embodies the correct perception that the question whether a body is commonly found in nature in a solid, liquid, or gaseous state is quite different from the question of its fundamental 'latent structure'. To make the distinction between the three 'states' the basis of a classification would be poor science. Indeed T.'s perception goes still deeper. All the known metals are among the chemical elements, and it is thus a most happy thought to give all of them the corpuscular structure of one of the 'roots' and not to account for them as compounds. Timaeus would be guided by the experience of workers in the various metals used in industry and art that they can all be liquefied at sufficiently high temperatures. Aristotle (?) partly, but only partly, agrees with the theory about metals. His view is that what is soluble by heat (τήκεται θερμῷ) is water, or at any rate, is mainly composed of water. Hence χρυσὸς μὲν δὴ καὶ ἄργυρος καὶ χαλκὸς καὶ καττίτερος καὶ μόλιβδος καὶ ὕαλος καὶ λίθοι πολλοὶ ἀνώνυμοι ὕδατος (*Meteorolog.* Δ. 389^{a} 7). But what is made harder by heat is earth or earthy. σίδηρος δὲ . . . γῆς μᾶλλον, ib. 389^{a} 11. With the statement of Timaeus cf. Seneca *Quaest. Nat.*

iii. 15. 2 in terra quoque sunt humoris conplura genera: quaedam quae mature durentur: hinc est omnis metallorum humus, ex quibus petit aurum argentumque avaritia, et quae in lapidem ex liquore vertuntur. in quaedam vero terra humorque putrescunt, sicut bitumen et cetera huic similia, where the theories reproduced are probably those of Posidonius, and are clearly based on our passage.

T. goes on to explain that the difference between *ὑγρά* and *χυτά* is that the former are made of the smallest icosahedra and that their particles are not all of one and the same size. This accounts for their ready mobility. Being made of such small particles, the *ὑγρά* are the more readily receptive of motions communicated from the particles of other things, and similarly the smaller particles of the liquid itself yield more readily to motion communicated from the particles which are rather larger. (*This* is what is meant by the reference to *ἀνωμαλότης* at d 8.)

58 d 6. γενῶν. A.-H.'s proposed correction *μερῶν* (ΜΕΡΩΝ) for *γενῶν* (ΓΕΝΩΝ) is, I suppose, palaeographically good enough, but the change seems needless. His objection to the MS. text is that the *ὑγρόν is* itself a *γένος* of *ὕδωρ*, as we have just been told, and ought not, therefore, to be said to 'participate' in the *γένη* of *τὸ ὕδωρ*. But I do not see why the different sizes of the particles, on the strength of which the division into *γένη* is made, may not themselves be called *γένη*, especially when we remember that *γένος* had not become a mere colourless *terminus technicus* in the fifth century, but retained the associations of the primary meaning 'clan', 'family'.

58 d 7. κινητικὸν . . . ὑπ' ἄλλου. The *ὑπ' ἄλλου* shows that *κινητικόν* here = 'mobile', 'easily set moving', a sense usually expressed by *κινητόν*. Commonly *κινητικόν* is contrasted with *κινητόν*, and means 'able to *impart* movement'. Hence Bekker, St. (in his edition of 1838), Martin, the Zürich editors, A.-H. all read *κινητόν* here; Hermann, St. (in the stereotyped Tauchnitz text), Bt. keep *κινητικόν*. This change to *κινητόν* has no MS. warrant, and should not be made. Adjectives in *-ικός* from verbs in *-έω* are not always transitive in sense. *κινητικός* itself is used several times by Aristotle in a neutral sense, as when he contrasts *κινητικὰ ζῷα* with the *ἀκίνητα ζῷα* which cannot move about but remain fixed at one spot (*Hist. Anim.* Δ. 528ª 30 *τὰ μὲν κινητικὰ αὐτῶν ἐστιν, οἷον ὁ κτείς (ἔνιοι γὰρ καὶ πέτεσθαι λέγουσι τοὺς κτένας . . .) τὰ δ' ἀκίνητα ἐκ τῆς προσφυῆς, οἷον ἡ πίννα*; ib. Θ. 590ª 33 *ὅσα δὲ κινητικά, τὰ μὲν ζωοφαγοῦντα τρέφεται τοῖς μικροῖς ἰχθυδίοις*. Cf. *de General. Anim.* Δ. 775ª 7). And there are other instances of the same kind (see Bonitz *Index* s.v.). So when Aristotle speaks of *τὸ κινητικόν* and *τὸ θρεπτικόν* as powers of the *ψυχή*, he means simply ability to move about and ability to take nutriment, not ability to move other things or to administer nutriment. See L. and S. for two similar examples from Plutarch *de primo frigido*.

ib. **αὐτὸ καθ' αὑτό.** This does not mean that *τὸ ὑγρόν* can set itself moving. Only *ψυχή* can do that. The meaning is that owing to the irregularities of the size of its particles (the *ἀνωμαλότης* of d 8) a motion impressed on some of the larger is easily passed on to the smaller.

58 d 8. τὴν τοῦ σχήματος ἰδέαν. Simply 'the shape'. The periphrasis is a curious one, since *ἰδέα* and *σχῆμα* were originally precise equivalents,

though σχῆμα was the word which ended by establishing itself for geometrical 'figure'. The σχῆμα contributes to the result, because, owing to the multitude of its triangular faces, the icosahedron is easy to disturb from equilibrium.

58 d 8—59 a 8. τὸ δὲ ἐκ μεγάλων . . . προσερρήθη. The χυτὸν γένος of 'water', the metals, are composed of larger particles of more uniform size. This explains why at all but very high temperatures they are solid. This γένος is πεπηγός 'frozen hard' by 'homogeneity'. That is, as the particles are larger, it takes more to make one of them move, and as they are of uniform size or nearly so, a movement imparted to one of them is not so readily propagated to others in its vicinity as it would be if these neighbouring particles were smaller. The case is altered if you apply *fire* to a mass of metal. The particles of fire, being the smallest of all, get in between those of the metal and break some of them up (διαλύοντος e 3, a point overlooked by A.-H. in his note). This disintegration does not happen to *all* the icosahedra simultaneously. It is gradual, as is indicated by the tense of διαλύοντος. Thus the metal loses its homogeneity and becomes more mobile. I. e. if any motion is communicated to the icosahedra which are still intact, it is now more readily passed on to those which have been broken up. The bulk of the mass also has been swollen by the entrance of the fire (it expands), and so it comes into violent collision with the surrounding air and is thrust down on the ground, where it runs along. The diminution or reduction of the ὄγκοι, the volumes or corpuscles, is what we call 'melting', and the 'stretching along the ground' we call 'flowing'. When the metal cools, i. e. when the intruding particles of fire escape again, the push of the surrounding air upon the molten metal, whose particles are still in an unstable condition, drives them into the spaces left vacant. Being thus packed together, the metal recovers its homogeneity. (The icosahedron formation which had been disturbed by the fire is now restored.) Since homogeneity means rest (cf. 57 e), this explains why the metal becomes solid again. We call the withdrawal of the particles of fire 'cooling' (ψῦξις) and the resumption of the rigid form 'freezing' or 'solidification' (πῆξις).

58 e 6. καθαίρεσιν. The word means literally 'reduction' or 'diminution'. Hence in arithmetic it may signify either subtraction (for which the preciser name is ἀφαίρεσις) or division, and in medicine the 'reduction' of corpulence, &c. by dieting. The καθαίρεσις of the ὄγκοι of the metallic mass plainly does not mean 'subtraction', 'reduction' of their number, since nothing is said of any expulsion of them. It must mean that the fire, of the 'cutting' and 'dividing' property of which we were told at 56 d, 'reduces' the bulk of the ὄγκοι, the icosahedra, by splitting some of them up. This is why the result is that the metal τὴν ὁμαλότητα ἀποβάλλει.

58 e 7. κατάτασιν may be noted as one of the exceptional cases in the dialogue where an obviously right reading has left no trace at all, so far as appears, in the MSS. and had to be replaced by pure conjecture. But the confusion between the compounds of -τασις and -στασις is a common one. T. seems to mean that the heated mass, set in motion

by the effects of the fire, is restricted by the 'pressure of the atmosphere' to a movement in contact with the surface of the earth. But for the atmosphere, the result might be vaporization off into space. It has been implied all along that there are *διάκενα* between the icosahedra; otherwise the particles of fire would not be able to make an entrance without dislodging something else, and nothing has been said of that.

59 a 1. οὐκ εἰς κενὸν ἐξιόντος. All that is meant is that there is not *mere* empty space in the direction taken by the retreating particles of the fire. There is air all round. (This does not exclude the presence of *διάκενα* between the particles of this air.) We are not told what expels the particles of fire. Presumably they simply keep on with their motion and make a way out through the molten metal for themselves.

59 a 3. εἰς τὰς τοῦ πυρὸς ἕδρας. As nothing is said to the contrary here, we must presume that the 'abodes' deserted by the fire have been left vacant until the 'push' which the atmosphere has received and passed on makes the particles of the metal close up again. An interpreter who wished to get the 'void' out of the theory might assume, as A.-H. does, that the impulse is communicated to the air by the escaping fire and that the whole process thus sets up a circular motion (*περίωσις*) or movement of antiperistasis, and that this is actually instantaneous. That the 'push' on the air comes from the escaping fire seems probable by comparison with the very similar account of freezing of water at 59 e 1 (*συνέωσται δὲ ὑπὸ τῶν ἐξιόντων εἰς αὐτό*). But the use of the present tense *συμμείγνυσιν* seems to imply that the motion is gradual, not instantaneous, for which we should rather expect the 'momentary' aorist to be used. In any case it is important to note that while the double process of liquefying and solidifying again is going on, *after* the particles of the water have been broken up by the fire and *before* they have recovered their *ὁμαλότης*, these 'floating' triangles are neither water nor any other 'root'. They are held in suspension, just like the 'faces' left when earth has been broken up by fire as described at 56 d. This is the 'swinging loose (*παραιώρησις*) of the triangles' to which we have found Aristotle objecting. Possibly A.-H.'s obscuring of this point is due to a secret sympathy with Aristotle's feeling that the 'suspended' triangles are a scandal. If they are, they are a scandal which an impartial exegesis is bound to find in the text. It cannot be extruded without doing violence both to the *διαλύοντος* of 58 e 3 and the *ἀπολαμβάνων τὴν ὁμαλότητα πάλιν* of 59 a 4–5, since the *ὁμαλότης* means precisely that constitution by icosahedra of uniform size which has been said to be characteristic of the *χυτά*. The icosahedra which are broken up by the fire are not supposed to have been converted into air and fire; they are still there when the fire leaves the mass, and only require to take their old places again. Hence in the interval their faces must be supposed to exist as 'floating' or 'vagrant' plane surfaces.

59 a 8–c 5. τούτων δὴ πάντων . . . ἰὸς λέγεται. A brief description of a few of the prominent metals and metallic products, gold, 'adamant', copper, verdigris. Gold has the finest and most uniform particles of them all, is very dense and has a ruddy gleam. The *πυκνότατον* of b 2 refers to the very great density or specific gravity of gold, some nineteen times that of pure distilled water at 4° C.

59 b 4. ἠθημένος διὰ πέτρας ἐπάγῃ. The suggestion is that the narrowness of the passage through the unyielding rock (quartz ?), hinted at by the expression that it is 'strained' or 'filtered' through, forces the particles of the molten metal close together and so effects solidification in the fashion just described.

59 b 4–5. χρυσοῦ ὄζος . . . ἐκλήθη. It is not clear what the 'adamant' of Timaeus is, except that it is something which he believed to be found in conjunction with gold, nor is it certain what sense he intends by calling it χρυσοῦ ὄζος. All we learn of it is that it is, like gold, of great density, but, unlike gold, very hard and that it has a dark colour. The expression χρυσοῦ ὄζος plainly does not mean 'scion' or 'offspring' of gold. As the Lexicon will show, ὄζος, like the Latin *nodus*, is used for the 'knob' or 'eye' in a tree out of which a branch grows. Hence the meaning here is likely to be what M. supposes, the 'core' or 'kernel' of gold. The poetic ὄζος in such expressions as Homer's ὄζος Ἄρηος as an epithet of a warrior was supposed in later times to mean 'scion', 'offspring', and Euripides, who imitates the phrase at *Hecuba* 123 by calling the two sons of Theseus ὄζω Ἀθηνῶν, certainly seems to have understood the word so. But according to modern etymologists ὄζος in the Homeric phrase is a different word from ὄζος, 'knob', 'kernel', and is connected with ὁδός, so that it would first mean *comes*, companion, and then 'henchman', 'squire'. If the Homeric association is present to the mind of Timaeus, the implication will be that the ὄζος χρυσοῦ is usually found along with or near gold. That there was something called adamant believed to be so found is shown by *Politicus* 303 e where it is said that ἀδάμας can only be separated from gold, πυρί, by smelting. Pliny (*N. H.* xxxvii. 15) speaks of a very rare and precious *adamas*, said by him to be a *gemma*, which is occasionally found in gold mines and is therefore called *auri nodus* (= χρυσοῦ ὄζος). M. holds that what Pliny means is the diamond, but that ἀδάμας in Greek never means this before the Alexandrian age. Since it is admitted that Theophrastus called the diamond ἀδάμας, I think it rash to assert that Plato could not have done so, but obviously it is not that which is meant here, as the diamond is neither metallic nor black.

59 b 6–c 3. τὸ δ' ἐγγὺς . . . γέγονεν. Copper has a structure resembling that of gold, but its particles are less uniform in size (εἴδη δὲ πλείονα ἑνὸς ἔχον), it is denser than gold, and also harder, the hardness being due to the presence of a little 'earth' in it. (Note εἴδη in b 6 virtually meaning 'atoms' or 'particles', lit. 'figures'.) Copper is, however, lighter than gold because it has large 'gaps' (διαλείμματα) between its particles. (Here once more we come on the assumption of τὸ κενόν.) Martin remarks that in what is said of 'adamant' and copper we seem to trace the false assumption that the hardness of a body—i. e. the cohesion of its parts—is directly proportional to its density. This is apparently what T. assumes, but to be strictly accurate you must not translate σκληρός as if it meant 'close-packed'. That is πυκνός, 'dense'. σκληρός means simply 'resisting the attempt to deform it by perpendicular pressure'. τὸ σκληρόν is that which you cannot 'poke' out of shape, the 'unyielding', as opposed to τὸ μαλακόν (Aristot. *de Caelo* Γ. 299^{b} 13 μαλακὸν μὲν γὰρ τὸ εἰς ἑαυτὸ ὑπεῖκον, σκληρὸν δὲ τὸ μὴ ὑπεῖκον). However, as T. is

assuming that τὸ πυκνότερον is also τὸ σκληρότερον, M. is substantially right. The assumption is easily explained when we see that Timaeus, in estimating density, takes into account only the volumes filled by the actual particles of a body and leaves the διάκενα between them out of his reckoning. As these διάκενα are inaccessible to actual observation, this way of estimating would never enable you to construct a table of comparative densities. This was impossible before the fundamental principle of hydrostatics had been apprehended by Archimedes in the middle of the third century. We judge of relative density by the comparison of the weights of two equal volumes of different substances under the same general conditions, thus counting in whatever διάκενα there may be as parts of the volumes compared. This explains how T. can make statements about densities which strike us as glaring errors. χαλκός (perhaps this means bronze, rather than copper, which is not 'hard') is thus said to be really denser than gold, though it notoriously weighs lighter, because it has considerable διάκενα in it. (The density of gold is given in the text-books as 19·3, that of copper as 8·9, that of brass as 8·2 to 8·7 according to the precise composition.)

59 b 7. τῇ μέν. I see no need for Hermann's alteration of τῇ to ἔτι. Strictly τῇ μέν, 'on the one side', implies as following τῇ δέ, 'but on the other'. The thought implied here would be 'denser than gold, but not so dense as "adamant"'. But there is no reason why Timaeus should be compelled to 'talk like a book'. He leaves his statement formally unfinished, as educated men continually do.

ib. **γῆς μόριον ὀλίγον καὶ λεπτόν.** The earth is only introduced into the composition to account for ἰός by the theory that it is earth which has worked to the surface of the metal. The earth is said to be scanty, to explain why there is not a thicker coating of ἰός on copper or brass which has been exposed to the air. And ἰός is only mentioned at all because one of the peculiarities of gold is that it does not 'rust'. Strictly the earth is regarded as no part of the metal; it is a foreign substance which works its way to the outside and so becomes visible 'in process of time'. It is presumably said to be 'earth' from a supposed resemblance to vegetable mould.

59 c 5–d 2. τἆλλα δὲ . . . ποιοῖτο. Another reminder of the uncertainty and provisional character of all our physical speculations. We might almost think that Plato is not only alive to the necessarily 'progressive' character of physical science, but is also aware of the need for a much firmer basis of experimental knowledge of physical facts than the fifth or fourth century possessed, before any detailed account of the contents of the physical world could be given which would be more than a pleasing pastime in intervals of relaxation from the serious study of the 'pure' sciences of metaphysics and mathematics. We do Plato a very grave wrong if we understand these warnings as the expression of a 'high priori' contempt for experimental knowledge. How clearly the Academy understood the need of a wide and accurate and systematized acquaintance with empirical fact is proved by the voluminousness of the biological works of men like Speusippus and Aristotle. It was not merely to illustrate the logical processes of division and definition that Speusippus wrote ten

books on biological homologies and discussed the proper classification of crustacea.

59 c 8. **καταθέμενος**, 'laying aside'. Tr. 'when for the sake of relaxation a man has laid aside discourse about what eternally is'. A.-H.'s reading *κατατιθέμενος* (a blunder of the diorthotes of A) and his rendering 'while laying down the laws of eternal being' are both impossible. The present tense is wrong, and to lay down laws is *νόμους τίθεσθαι*, not *κατατίθεσθαι*. And the middle voice regularly implies that the giver of the law is also one of the body for whom it is laid down.

59 d 2. **παιδιάν.** The free play of fancy in devising such hypotheses as we are now to get is *παιδιά*, 'sport', 'amusement' by comparison with the hard work of the Pythagoreans and Academy in pure mathematics. But it is also a thought of Plato's later life that very likely from God's point of view all human achievements are not so very serious; they are all a *φρόνιμος παιδιά*. As the Athenian says at *Laws* A. 644 d 7 *θαῦμα μὲν ἕκαστον ἡμῶν ἡγησώμεθα τῶν ζώων θεῖον, εἴτε ὡς παίγνιον ἐκείνων εἴτε ὡς σπουδῇ τινι συνεστηκός· οὐ γὰρ δὴ τοῦτό γε γιγνώσκομεν.*

59 d 2—60 b 5. **ταύτῃ δὴ . . . ἐπωνομάσθη.** We come now to the second class of kinds of *ὕδωρ*, the *ὑγρά*, and an attempt is made at a classification of the principal varieties. Ordinary 'water' is one, and, in connexion with it, a theory is given of hail, ice, snow, frost. Four other chief kinds of liquid are then distinguished: (1) wines, (2) oils, (3) honeys, (4) *ὀπός*. None of the liquids described are regarded as chemically pure *ὕδωρ*; all, including ordinary 'drinking-water', contain an admixture of fire.

ib. **ταύτῃ δὴ καὶ τὰ νῦν ἐφέντες** (*ἐφέντες* WY, *ἀφέντες* AF). *ταύτῃ* refers back to the *παιδιά* of the last sentence; *τὰ νῦν* may be taken as directly governed by the participle, 'handing over to it (the pastime just mentioned) the present subject'. But it is perhaps more idiomatic to take *τὰ νῦν* as an adverbial accusative and *ἐφέντες* as absolute = *ἐφέντες τὰς ἡνίας*, 'let us now give it its head'. A.-H.'s 'setting out in this way' does not seem to me a possible rendering. It looks like a confused recollection that the middle *ἐφίεσθαι* with a genitive means to 'go for', 'aim at'. The equally supported *ἀφέντες* gives no tolerable sense.

59 d 4–e 5. **τὸ πυρὶ μεμειγμένον ὕδωρ . . . λέγεται.** The general theory is that common water contains *ὕδωρ* with an admixture of fire. On the removal of the particles of fire it is solidified in the fashion already described in 58 e, and becomes hail, ice, snow, or frost, according to the region in which the process happens and other particular circumstances.

59 d 4. **ὑγρόν.** As the next line shows, there is intended to be an etymology of the word *ὑγρόν*, which, it is worth while to remember, is not exclusively applied to 'liquids', but means 'supple', *maniable*, and is used in Greek of such things as a supple lash of leather or the supple youthful frame. The precise etymology meant has to be divined from the explanation given in the words *διὰ τὴν κίνησιν . . . ἐπὶ γῆς*. Stallbaum supposed that a derivation from *ὕω* was intended, but this seems to me out of the question, since T. expressly says that the name is derived from the path which the water describes *κυλινδούμενον ἐπὶ γῆς*. Thus *γῇ* is plainly meant to enter into the derivation, as was supposed by Lindau,

who suggested that ὑγρόν is treated as = ὑπὲρ γῆς ῥέον. C. W. attacks A.-H. for accepting this explanation, but not, as I think, on good grounds. He complains that ὑπέρ and ῥέον are not brought into the phrase used by T., but, as we have the equivalent κυλινδούμενον ἐπί, I do not think this a serious objection. C. W. also complains that ὑπὲρ γῆς ought to mean 'up above' the earth, as it does in e 2, and this is more to the point. But I take it ὑπὲρ γῆν ῥέον is what is really meant, i. e. I think τὴν κίνησιν is meant to suggest the ῥοή, and the rest of the phrase enables us to supply ὑπὲρ γῆν. C. W. raises the question what verb is to be taken with the words ὅσον λεπτὸν ὑγρόν τε. Ought we to regard them as subjects of λέγεται or to take λέγεται as the verb of the relative clause ἣν . . . λέγεται? The first was the view of St. who proposed to understand an ἐστί with κυλινδούμενον; the second is that of Hermann (followed by A.-H.), and indicated in their editions by a comma placed after ὁδόν. I think the second clearly right, since, as A.-H. says, it co-ordinates λεπτόν, ὑγρόν, μαλακόν (of d 6). C. W. also decides in favour of this, but complains that there is a difficulty not accounted for, viz. that it seems unreasonable to say that ὕδωρ *is* ὑγρόν *because* of its flowing; the fact is rather that it flows because it is ὑγρόν. I am inclined to think this hypercritical. All supple things are ὑγρά, and I see no real difficulty in saying that water is supple 'in virtue of' (διά) the path it takes on the surface of the earth. So we are told that ὕδωρ is soft τῷ ὑπείκειν, where a hypercritical person might equally object that it really ὑπείκει τῷ μαλακὸν εἶναι. Both Lindau and St. objected to the text on the ground of the repetition of the word ὑγρόν. It seems to me that A.-H. is right in holding that this is sufficiently excused by the introduction of the etymology. No one who has studied the *Laws* should be blind to the fact that a certain tendency to verbal repetition is a real characteristic of the writings of Plato's old age. To take the first example that occurs to me, cf. *Laws* B. 672 b 7 ἐγὼ δὲ τὰ μὲν τοιαῦτα τοῖς ἀσφαλὲς ἡγουμένοις εἶναι λέγειν περὶ θεῶν ἀφίημι λέγειν, or *Laws* B. 673 e 8 εἰ δ' ὡς παιδιᾷ τε, καὶ ἐξέσται τῷ βουλομένῳ καὶ ὅταν βούληται καὶ μεθ' ὧν ἂν βούληται πίνειν. This is not how Plato wrote at an earlier time.

59 d 7. ἀέρος τε. A.-H. feels a suspicion about the genuineness of the words. Nothing is said in the context about 'air' as an ingredient in common 'water'. One might suggest that some of the particles of the ὕδωρ would be broken up and reconstituted as air by the action of the fire—in fact, it would be partly vaporized—and that this is how ἀήρ comes to be mentioned. I should think this a complete explanation but for the fact that nothing was said of any similar vaporization of the χυτά in the description of the action of fire on them at 58 e. But perhaps the reason is that they would only vaporize at enormous temperatures, whereas the formation of steam is a familiar fact which is therefore mentioned.

59 e 2. παγέν. Thus indirectly 'freezing' is regarded as a consequence of heat, since it is a consequence of the escape of the 'fire' (and steam?) from the ὕδωρ. We may probably see the hint for this theory in the doctrine of Empedocles that the 'shell' of the κόσμος is 'air' which has been frozen hard by the agency of fire, Aetius *Placita* ii. 11. 2

(*Doxogr. Gr.* 339 = R. P. 170 c) Ἐμπεδοκλῆς στερέμνιον εἶναι τὸν οὐρανὸν ἐξ ἀέρος συμπαγέντος ὑπὸ πυρὸς κρυσταλλοειδῶς. Empedocles possibly argued from the action of fire in baking clay. If so, T. is improving on him by offering an explanation of the mechanics of the process. The theory thus is (59 e 3–5) that when the freezing is complete you get hail or ice according as the process takes place above the earth or at its surface; when the freezing is only partial (i. e. the 'thrusting together' of the particles of ὕδωρ less violent), you get in the first case snow, in the second frost or rime. Aristotle (?) presumably intends a tacit correction of Timaeus when he mentions κρύσταλλος, χιών, χάλαζα, πάχνη as cases of solidification ὑπὸ ψυχροῦ, and contrasts this with πῆξις due to τὸ θερμόν as shown by κέραμος, τυρός, νίτρον, ἅλες (*Meteorolog.* Δ. 388^{b} 11).[1]

59 e 5–60 a 3. τὰ δὲ δὴ πλεῖστα . . . παρέσχοντο. Bt.'s punctuation seems to indicate the grammatical construction. The words from σύμπαν to λεγόμενοι are inserted parenthetically. On the resumption of the main sentence, as is common in such cases, a δέ is inserted, on the same principle as '*δέ in apodosi*', without any preceding μέν. (The μέν of 59 e 6 is a *μέν solitarium*.) A.-H.'s view, which treats the whole sentence down to λεγόμενοι as a single enunciation, has the awkwardness, objected to by C. W., of requiring us to treat λεγόμενοι as equivalent to a finite verb, 'are called'. This is not absolutely without parallels in Plato, but is rare. A.-H. holds that χ. λεγόμενοι means 'the so-called saps'. I think that, as there is no definite article, λεγόμενοι should rather be regarded as put for λεγόμενον by the common assimilation in cases of this kind to the gender, &c., of the 'complement'. Thus tr. 'The most numerous forms of water when intermingled—the whole group, being strained through plants, being called saps—', where the διὰ τῶν ἐκ γῆς φυτῶν ἠθημένα explains the reason for using the name χυμός of the whole genus, though it is not really very applicable to πίττα or μέλι.

60 a 2. σχόντες. One would expect σχόντα, since the subject is τὰ πλεῖστα εἴδη τῶν ὑδάτων, but the gender of χυμοί in the parenthesis exercises an influence on the main sentence after its resumption.

60 a 3. ἔμπυρα. These compounds with ἐν- have regularly one of two meanings: (*a*) 'having *x* in it', so ἔνθερμος, ἔμψυχος, ἔνθεος, ἔμφρων, and the like; (*b*) 'being in *x*', so ἔγγαιος, ἐνουράνιος, ἔνδημος, ἐμφύλιος. The sense of a particular compound is usually determined by usage, but the same compound, in some cases, may have either meaning according to context. ἔμπυρος in the sense of 'on' or 'in' the fire is very rare; the word usually means hot, fiery, enflamed, and the like (see L. and S., s. v.). Here the sense is quite literally 'having fire in them'. The four kinds of χυμοί which have fire in them are οἶνος, ἔλαιον (κίκι and πίττα

[1] Seneca (*Quaest. Nat.* iv. 3), in a mutilated chapter propounds, without committing himself personally, the views of Posidonius on snow, hail, &c., which, he says, were given with as much confidence as though P. had seen all the processes with his own eyes, 'Grandinem enim fieri ex nube aquosa, iam et in humorem versa, sic adfirmabit tanquam interfuerit'. The difference between snow and hail is then explained by the greater completeness of the freezing and the more remote region in which it takes place in the second case. This is pretty much the view of T. So Seneca himself, op. cit., iv. 8 'aiunt nivem in ea parte aeris fieri quae prope terras est'.

are ranked under this head), *μέλι*, *ὀπός*. All of them are composed of particles of non-uniform size.

60 a 4. αὐτῶν. The position of the word is due to 'hyperbaton'. It is to be taken as a partitive genitive with *εἴδη*.

60 a 6. διακριτικὸν ὄψεως. The *ὄψις* is the visual ray proceeding from the eye of which we have heard as the true agent in vision. Why a thing which readily 'divides' this ray should have a bright (*λαμπρόν*), gleaming or glistening (*στίλβον*), glossy (*λιπαρόν*) appearance will be explained in connexion with the theory of colour-vision at 67 e 4 ff., q. v. It is no doubt with a veiled polemical allusion to this passage that Aristotle (*de Generat. Animal.* B. 735^{b} 24) remarks that *ἔλαιον* owes its gloss (*τὸ λιπαρόν*) not to the presence of earth (as seems to be hinted by the words of Timaeus at 60 a 1 *διὰ τῶν ἐκ γῆς φυτῶν ἠθημένα*), but to that of wind (*πνεῦμα*), *ἔστι γὰρ οὔτε γῆς οὔτε ὕδατος ἀλλὰ πνεύματος τὸ λιπαρόν*. He means that neither the fact that *ἔλαιον* is a form of *ὕδωρ* nor the fact that there is earth in the plants from which it is obtained will account for the 'gloss'. Aristotle's reason for denying that olive oil contains earth comes out in the next sentence. It is lighter than water, and therefore as earth is heavier than water, *ἔλαιον* cannot be a compound of the two. Timaeus, indeed, has not explicitly said that *ἔλαιον* does *contain* earth, but as he has suggested that the peculiarities of the *χυμοί* are accounted for by the 'filtering' through 'soil', the 'score' is a fair one. (*κίκι* is said to be castor oil.)

60 a 8–b 1. ὅσον . . . συνόδων. A.-H. is clearly right about the construction and meaning of these words which had been misapprehended by the earlier editors. *φύσις* = normal state or condition. For this common sense of the word cf. *infra*, 64 d 1 *τὸ εἰς φύσιν ἀπιὸν πάλιν ἀθρόον ἡδύ*, 'the return, on a sufficient scale, to one's normal condition is pleasant', Aristot. *Met.* Δ. 1015^{a} 13 *ἡ πρώτη φύσις καὶ κυρίως λεγομένη ἐστὶν ἡ οὐσία ἡ τῶν ἐχόντων ἀρχὴν κινήσεως ἐν αὑτοῖς ᾗ αὐτά*, *E. N.* K. 1173^{b} 7 *καὶ λέγουσι δὲ τὴν μὲν λύπην ἔνδειαν τοῦ κατὰ φύσιν εἶναι, τὴν δ' ἡδονὴν ἀναπλήρωσιν*. So here the construction is *ὅσον διαχυτικὸν τῶν περὶ τὸ στόμα συνόδων μέχρι φύσεως*, where *περὶ τὸ στόμα* is the usual periphrasis for *τοῦ στόματος*; 'all that *διαχεῖ*, relaxes or dilates, the passages of the mouth—i. e. those which convey tastes—to their normal condition'. Some juices unduly contract these passages; honey and 'sweet things' generally dilate them again to their normal state. A.-H. deserves credit for correcting the errors into which St. and M. had fallen about this simple expression. But it is fair to mention that Ficinus at any rate understood the *grammar*; since he renders 'quod oris angustos meatus ad penetralia usque naturae perfundit'. The sense he clearly did not understand.

60 b 3. τῷ κάειν. 'By corroding.' It is called 'burning' by the common and natural confusion of that which produces a 'burning' sensation with that which actually effects partial combustion. The sensation of contact with what corrodes is so like that of contact with a hot wire or the like that the two physical processes come to be thought identical.

60 b 4. ἐκ πάντων ἀφορισθὲν τῶν χυμῶν. Does this mean 'secreted

from all vegetable juices' (A.-H.), or only 'distinguished from' all other χυμοί (M.)? It seems to me that A.-H. was right in adopting from T. Taylor 'the Platonist' the former interpretation. We must understand that ὀπός is not present in *equal* quantity in all the χυμοί. The remark has a point if T. holds that there is a 'tang' or after-taste of the 'corrosive' in all juices. If he only means that it is different from the others, the statement seems not worth making. Also with ἀφορίζω in the sense to 'separate' or 'distinguish' we regularly have either the simple 'genitive of separation' (so regularly in Plato) or the genitive with ἀπό. It is a pity that A.-H. did not venture to *translate* according to his convictions.

60 b 5. ὀπός. The word seems from the lexicons to have been used of the juices of plants generally, but specially of that of the wild fig-tree, which was used, as we use rennet, to curdle other liquids. M. supposes that what is meant here is opium (which notoriously has an acrid taste), but, in the absence of any other proof that the word was used of poppy-juice in the fourth century, this seems doubtful. Apart from its application to the juice of the wild fig, the word was also used specially of that of the extinct silphium. 'Verjuice' (A.-H.) is a good rendering, precisely because it suggests to most of us nothing more definite than a disagreeably acrid taste. The *N. E. D.*, however, says that the word means more particularly the juice of sour apples, grapes, or the like employed in cooking. This makes it a really excellent rendering of ὀπός, if the word here means the juice used for curdling.

Aristotle (?) seems to have the statements of T. about the χυμοί in his mind at *Meteorolog.* Δ. 388ª 29 ff. Honey is said there to be a compound of earth and air, and ἔλαιον of water and air. Wine is said to be more difficult to deal with, the reason being that the name οἶνος is given to more than one kind of thing (ὅτι οὔτε ἑνὶ εἴδει λέγεται ὁ οἶνος καὶ ὅτι ἄλλος ἄλλως). New wine contains more earth than old.

60 b 6—61 c 2. γῆς δὲ εἴδη . . . συμπήγνυται. We come now to the varieties of earth, which are described at some length: (*a*) stone, 60 b 6–c 7; (*b*) κέραμος, 60 c 7–d 2; (*c*) [?], 60 d 2–5; (*d*) soda and salt, 60 d 5–e 2; (*e*) combinations of earth and water which are not soluble by water but only by the application of fire, viz. certain kinds of 'stone', wax, aromatics, 60 e 2—61 c 2.

(*a*) *Stone.* Stone results from a combination of earth and water. The particles of water are broken up in their encounter with those of earth and converted into air, and then escape. They communicate a violent impulse to the contiguous atmosphere which is thus thrust down against the mass of earth from which the escaping air has emerged and compresses it. Hence the hardness of the rocks formed in this way. (Of course T. is overlooking an obvious difficulty. Why does not the air which comes into collision with the lump of earth simply enter the places left vacant by the water turned into air which has just escaped?)

60 b 6. γῆς δὲ εἴδη. εἴδη is strictly a notion which is split up by 'partitive apposition', the words which stand in this relation to εἴδη then being made the grammatical subjects of a series of three separate sentences, τὸ ἠθημένον διὰ ὕδατος (b 6), τὸ ὑπὸ πυρὸς τάχους ἐξαρπασθέν (c 7).

τὼ δ' αὖ . . . ὄντε (d 4–6). In English we have to replace this construction by an 'adverbial' phrase, 'as for the forms of earth'.

60 b 8. εἰς ἀέρος ἰδέαν. Here quite literally 'into the *figure* of air', the icosahedra of the water being reorganized as octahedra.

60 c 1. εἰς τὸν ἑαυτοῦ τόπον ἀναθεῖ. No special impulse is needed to expel the newly-formed air. It tends to move towards the general cosmic mass of air in virtue of that 'drift' of like to like which was described at 52 e—53 a, and is supposed still to subsist as a subordinate tendency even in the ordered οὐρανός. The process also illustrates what was meant by the διαμείβεται τὰς χώρας of 57 c 1. The 'new air', which had formerly been water, has now a tendency to move in a direction different from that towards which it tended while it was still water. The next words must not be strained to mean that there are no διάκενα in atmospheric air. All that is meant is that there is already something in the region into which the 'new air' escapes, viz. the surrounding atmosphere. ὑπερεῖχεν may be noted as a case where the *diorthotes* of A and the scribe of Y or its original have both corrupted a correct text by a blunder about the division of the letters. The diorthotes of A then goes on to corrupt the αὐτῶν, which ought to have put him on the right track, in order to restore the grammar which he has himself destroyed.

60 c 2. ἅτε ὢν βαρύς. But why should the atmospheric air be βαρυς? T.'s theory of weight and lightness (62 c 3—63 e 8) is one of the most brilliant things in the whole dialogue, and the point of it is that it makes 'heaviness' and 'lightness' purely relative notions. That is 'heavy' in any region of the universe which it is hard to dislodge from that particular region. But atmospheric air is not hard, but easy, to dislodge from the neighbourhood of the earth, and is therefore, on T.'s own theory, not 'heavy' but 'light' in our neighbourhood. I cannot reconcile what is said here with the theory. Even if T. only means that the atmospheric air is heavy by comparison with the νέος ἀήρ formed by the conversion of the water, it is not obvious why there should be this difference. T. may conceivably mean only that air is not without weight, and that consequently when it is pushed into contact with a subjacent body it compresses it. But he *seems* to mean that air has a relatively great weight, and therefore produces an *extreme* compression (σφόδρα ἔθλιψεν συνέωσέν τε αὐτόν). He has given no reason why we should make this assumption, and could have had no means of detecting the real magnitude of 'atmospheric pressure'. (Not to mention that 'atmospheric pressure' would exist before the 'new air' had made its escape as much as afterwards.) I do not see how T. can be acquitted of confusion of thought here. Why is the atmosphere pushed *down* rather than in any other direction? The movement must be supposed to be a circular process of the kind called by Plato περίωσις and by later writers ἀντιπερίστασις. This is the only kind of movement which can be supposed to take place in a bounded *plenum*. But it does not follow that a world in which such a movement occurs must be a *plenum*. In a bounded sphere, like the οὐρανός of Timaeus, continued motion will ultimately result in a περίωσις, whether the sphere contains διάκενα or not.

60 c 4. ἀνῄει. The variants *ἀνίη*, *ἀνείη* are interesting as showing the indistinguishability of all these forms in pronunciation at the date when the immediate archetypes of our MSS. were written.

60 c 5. συνωσθεῖσα . . . γῇ. A.-H. wishes to take *ἀλύτως ὕδατι* together. But this gives a poor sense. T. can hardly have thought it necessary to say that stone is not soluble in water. It seems better to follow St. and M. in joining *ἀλύτως* with *συνωσθεῖσα*, 'earth pressed by air into indissoluble conjunction with water'. A.-H. urges that *all* the water in the original mass is supposed to have been converted into air. But T. never actually says as much as this, and I think the fact that in the very next sentence he dwells on the point that *all* the *νοτερόν is* expelled in the case of *κέραμος* shows that he means that it is *not* all expelled in the formation of *λίθος* and *πέτρα*. (Aristotle (?) also speaks of *κέραμος* as containing no water, *ὅσων μὲν οὖν ἅπαν ἐξικμάσθη, οἷον κέραμος ἢ ἤλεκτρον*, *Meteorolog.* Δ. 388^{b} 18, but actually says that *λίθοι πολλοὶ ἀνώνυμοι* are forms of water, ib. 389^{a} 8.)

60 c 7–d 2. τὸ δὲ ὑπὸ πυρὸς τάχους . . . γέγονεν. (*b*) *κέραμος*, 'pot', 'earthenware'. When the *whole* of the moisture is rapidly exhausted by heat, we get a more brittle substance than 'stone', *κέραμος*, 'pot'. T. is alluding to the fact that the result is, in this case, produced artificially by 'firing' the clay.

60 d 2–4. ἔστιν δὲ ὅτε . . . λίθος. (*c*) A third case is when earth is made *fusible* by fire (as is possible when some of its moisture remains), and then cooled. A.-H. is not justified in regarding this case as antithetical to the formation of *λίθος* and arguing from it that in case (*a*) *no* moisture is left. (*a*) is clearly meant to be antithetical to (*b*) the formation of *κέραμος*. In the case of (*a*) we had not to take *fire* into account at all; in (*b*) and (*c*) we consider the two possible cases of the action of fire on a mixture of earth and water, according as the water is wholly or only partly expelled. We cannot therefore argue as if (*c*) was being contrasted with (*a*).

60 d 4. γίγνεται τὸ μέλαν χρῶμα ἔχον λίθος. This (except for the substitution of *γέγονε* for *γίγνεται*) is the best attested reading (FWY), but makes no satisfactory sense, since it means 'that which has the black colour (or, *a* black colour) becomes stone (or, *a* stone)'. This is grammar, but clearly not good sense. We need an account of the formation of some specific stone. A's *τὸ μέλαν χ. ἔχων λίθος*, 'a stone which has the black colour', though defended by Martin, means little better than nonsense, and *ἔχων* in that MS. is pretty clearly a mere copyist's error for *ἔχον* due to the following *λίθος*. (The archetype of A presumably had the *ἔχον* which the *diorthotes* wished to restore.) A.-H.'s proposed reading *ὃ τὸ μέλαν χ. ἔχων λίθος*, 'the stone with the black colour is formed', has two faults. It mistakes the *ἔχων* of A for the genuine text, and it suffers itself from an intolerably superfluous *τό*. C. W. suggests *ὃ μέλαν χρῶμα ἔχων λίθος*, but (*a*) this also assumes falsely that *ἔχων* was the original reading of the archetype of our MSS., and (*b*) is there only one 'black stone' in the world? St. thinks—he reads *ἔχον*—that 'any black stone' is meant, but this seems absurd. Lindau, with the same reading, guessed that basalt was meant, and M., reading

ἔχων and apparently not knowing that ἔχον is more than a variant of 'early editions', guesses lava. Either may be right in his guess, but neither can claim to get it out of the words. I cannot believe that the text of FWY is what Plato wrote, but the error clearly goes back to the archetype of all our existing MSS., and it is best to print it, and to admit that we have no means at present of restoring the genuine words. It may be that all that is wrong is the loss of an adjective agreeing with λίθος which would make it clear what stone is meant. (χυτὴ γῇ is in any case the subject to ψυχθῇ, not to γίγνεται, as A.-H. seems to assume.) C. F. Hermann's εἶδος for λίθος is rewriting rather than emendation, but it is possible he was right in thinking that λίθος is the peccant word.

60 d 4–7. τὼ δ' αὖ . . . ὑφ' ὕδατος. Schneider's correction which restores the dual nominatives throughout the passage for the datives of the MSS. (τώ, ἀπομονουμένω, ἁλμυρώ, οὔτε, λυτώ) seems to me to approve itself on inspection as right. The scribes have very little authority on such a point as the presence or absence of the 'subscript' ι. I would, however, suggest that perhaps ἡμιπαγεῖ should be retained, since it seems fairly established from inscriptions that this is the correct form for the dual nominative in such words in the fourth century. At 88 c 1 all good MSS. seem to give the form ὑγιῇ as a dual, but the scribes are no authorities on such a matter, and if, for the sake of uniformity, we are to make a choice, it seems better to prefer in both places the form which Plato is pretty certain to have written to that which has been accepted on the authority of the late grammarians. (η and ει would be indistinguishable in sound in their time.) If the datives are retained, τῷ ἀπομονουμένῳ . . . καὶ λυτῷ has to be taken as an 'instrumental' dative, but the construction seems harsh and unnatural. The meaning is that soda and salt are deposits or residues left by the evaporation of a great quantity of brine, the underlying thought, no doubt, being that salt is what is left behind by the evaporation of sea-water. Cf. the theory of Anaximander, Aetius *Placita* iii. 16. 1 (*Doxogr. Graec.* 381 = R. P. 20 a) *τὴν θάλασσαν εἶναι τῆς πρώτης ὑγρασίας λείψανον, ἧς τὸ μὲν πλεῖον μέρος ἀνεξήρανε τὸ πῦρ, τὸ δὲ ὑπολειφθὲν διὰ τὴν ἔκκαυσιν μετέβαλεν.* The contents of salt-pans would be what is left after the burning has been carried a stage further. The doctrine was retained by Anaxagoras (*Placit.* ib. 2). According to Aristotle (*Meteorolog.* B. 358ᵃ 3 ff.), the cause of the saltness of sea-water is not that it contains earth but that it contains an 'unconcocted' (ἄπεπτος) 'fuliginous vapour' arising from the surrounding land (καπνώδης ἀναθυμίασις); Theophrastus seems to have kept closer to the old Ionic view. (Olympiodorus in *Meteorologica*, fol. 34 b, Ideler i. 286 *τοῦτο γὰρ οὐ περιπατητικὸν ἀλλὰ θεοφράστειον· εἰ γὰρ [? θεοφράστειον, εἴ γε] Θεόφραστος τοῦτο ἔλεγεν, ὅτι ἡ ὑποκειμένη γῆ αἰτία ἐστίν κτλ.*)

60 d 7. ἐλαίου καὶ γῆς. Since soda was used (in composition) as a soap (cf. e.g. Aristophanes *Frogs* 710–11 *ὁ πονηρότατος βαλανεὺς ὁπόσοι κρατοῦσι κυκησιτέφρου | ψευδολίτρου κονίας*), I do not understand why A.-H. finds any difficulty about καὶ γῆς. Soda certainly does cleanse from 'grease and dirt'.

60 d 8. τὸ εὐάρμοστον ἐν ταῖς κοινωνίαις περὶ τὴν τοῦ στόματος αἴσθησιν,

i. e. 'entering readily (or agreeably) into blends of tastes', that is, forming an agreeable or wholesome seasoning for articles of food.

60 e 1–2. κατὰ λόγον [νόμου]. Though it is the one reading with MSS. authority, *κατὰ λόγον νόμου* cannot be right as it stands. It cannot e. g. mean 'in the *words* of *the* ordinance' (A.-H.), but only 'according to the formula of custom' or 'of an ordinance', and neither phrase is intelligible. Bt. seems right in holding that the words have arisen from a *doublette*, *κατὰ νόμον* / *κατὰ λόγον*. But is he right in supposing *κατὰ λόγον* to have been the original text? What would *κατὰ λόγον* mean here, and how did it come to be explained by *κατὰ νόμον*? It should mean 'proportionately', *secundum rationem*, 'in a concatenation accordingly', and this does not seem to make sense. Should we not eject *λόγον* and read *κατὰ νόμον*, the words going closely with *θεοφιλές*?[1] The sense would be that salt is 'by usage a sacramental substance'. The reference is to its ceremonial uses, the particular use of which T. is thinking being presumably the mixing of it with the barley meal (*οὐλόχυται*) ritually sprinkled on the head of the sacrificial victim.

With this passage should be compared Plutarch's little essay (*Quaest. Conviv.* v. 10. 684 F ff.) on the question why Homer (*Iliad* I. 214) calls salt 'divine' (*πάσσε δ' ἁλὸς θείοιο*). Plutarch, who cites the present passage, read here *κατὰ νόμον ἀνθρώπων* or *κατ' ἀνθρώπων νόμον*, and his latest editor would restore the latter form in Plato, regarding *λόγον* as a corruption of *ανων* (sc. *ἀνθρώπων*). Plutarch suggests that salt is 'divine' either because it preserves things from 'going bad', or, possibly, because it promotes fertility. For, he says, animals breed better if fed on salted food, and sea-water fishes are notoriously prolific. Another remark comes nearer to something which may really be in T.'s mind. Men deify the most universal necessaries of life, water, corn, wine, &c.; and salt is one of these necessaries. (This is a piece of early 'sophistic'; Prodicus regarded such deities as Demeter and Dionysus as personifications of corn and wine, a thought afterwards adopted and developed by the Stoics.)

60 e 2—61 a 3. τὰ δὲ κοινὰ . . . λέλειπται. There are also certain compounds of earth and water which are not soluble in water but yield only to fire. The explanation of this is as follows. Fire cannot normally break up a mass of earth, nor yet can air, because the vacant interstices between the cubes of earth are larger than the tetrahedra of fire and octahedra of water, which readily pass through them. This comes direct from Empedocles, who taught that some of the 'roots' run readily through the *πόροι*, 'passages', in the others, and made this the basis of his theory that 'like' is perceived only by 'like'. The 'unlike' either cannot get into the *πόροι* at all or runs through them without contact. Theophrastus *de Sensu* 7, *Doxogr. Graec.* 500 = R. P. 177 b. But the particles of water, being larger than those of fire and air, have to force a passage between the particles of earth, and so they dissolve the mass. Normally the earth is not inflammable or vaporizable but is soluble in water. But

[1] For a parallel case cf. Aristot. *E.N.* 1138ᵃ 10 where we have to choose between the readings *τὸν ὀρθὸν λόγον* and *τὸν αὐτόν νόμον*, the latter being pretty clearly right.

very forcibly compressed earth only permits a passage to the finest particles of all, those of fire, and is therefore soluble only by fire.

60 e 4. γῆς ὄγκους. The ὄγκοι meant are not the individual corpuscles, but aggregates of them, as we see from the details which follow. The dissolution discussed is that of a mass into its molecules, not the breaking up of the molecule into its constituent faces. Aristotle (?) more rigorously insists that whatever is 'soluble by fire' is water, or composed in the main of water (*ἐπεὶ οὖν τηκτά γε θετέον καὶ ὅσα τήκεται ὑπὸ πυρός, ταὐτ' ἐστὶν ὑδατωδέστερα, Meteor.* Δ. 388^{b} 32).

60 e 5. τῶν διακένων. As usual, the existence of these 'empty' interstices is taken for granted. T.'s whole scheme is quite unintelligible except on the understanding that it involves the reality of the *κενόν*. The remark that the interstices in the present case are 'too large for' the tetrahedra of fire shows how useless it is to attempt to reduce the amount of *κενόν* in T.'s *οὐρανός* to the infinitesimal.

61 a 3–7. τὴν δ' ὕδατος . . . πῦρ. This is a momentary digression from the subject immediately in hand. T. explains that, on the principle just laid down, water which has been very violently compressed is only resoluble by the action of fire, while air, whether under violent compression or not, can only be broken up by fire. This is so because the larger corpuscles cannot get in between the smaller. Thus T. is assuming that there are everywhere *διάκενα* between corpuscles but that the *διάκενα* of any one of the four bodies are smaller than its corpuscles. Hence in the normal condition of water, both air and fire can get into its *διάκενα*; the result, if air is the intruder is merely to increase the distances between the particles of the water (*ὁ μὲν κατὰ τὰ διάκενα*), but if the intruding particles are fire, which is *τμητικώτατον καὶ ὀξύτατον* (56 a 7), the particles of water may be actually broken up into their 'triangles' (*κατὰ τὰ τρίγωνα*). This may mean 'into their equilateral triangular faces', or might include the further resolution of the faces into the 'primary' triangles of all. It is not clear that Timaeus intends to distinguish the two cases. C. W. indeed asserts that only the former is ever contemplated and censures A.-H. for regarding the latter as possible. But in the corresponding statement about highly compressed air we are told that nothing can dissolve it, *πλὴν κατὰ τὸ στοιχεῖον*. Now, at 54 d 5, it was the right-angled scalene triangle which was called the *στοιχεῖον* of fire, air, water. Hence it seems natural to suppose that the word is used in the same sense here. Yet T. can hardly mean that a tetrahedron of fire getting in among the corpuscles of the condensed air *always* breaks them up as completely as this. Cf. 56 c 8—57 c 6, where nothing more than the regrouping of the equilateral triangles seems to be under contemplation. I can only conclude that T. has never definitely asked himself whether the process of breaking-up is supposed to stop with the resolution of a particle into equilateral faces or goes farther. In any case there is a want of uniformity between the present passage and 56 d 6. We were told there expressly that a particle of water could be converted into one of fire and two of air *ὑπὸ πυρὸς εἴτε καὶ ὑπ' ἀέρος*. Here we are told equally confidently that the intrusion of air into water only separates the particles of water *κατὰ τὰ διάκενα*, and that only if the water is not

under high compression. We have no right to shut our eyes to these inconsistencies of detail. What T. is attempting to account for in the present passage is, apparently, the fact that 'cloud', which is condensed 'air', may either come down in rain, or, if the condensation is extreme, it bursts, and lightning (fire) comes out of it. The explanation takes us back to Milesian views, especially to those of Anaximenes. Cf. Aetius *Placita* iii. 3. 1–2 (*Doxogr. Graec.* 367) *Ἀνιξάμανδρος ἐκ τοῦ πνεύματος ταυτὶ πάντα συμβαίνειν· ὅταν γὰρ περιληφθὲν νέφει παχεῖ βιασάμενον ἐκπέσῃ τῇ λεπτομερείᾳ καὶ κουφότητι, τότε ἡ μὲν ῥῆξις τὸν ψόφον, ἡ δὲ διαστολὴ παρὰ τὴν μελανίαν τοῦ νέφους τὸν διαυγασμὸν ἀποτελεῖ. Ἀναξιμένης ταὐτὰ τούτῳ κτλ.* Anaxagoras (ib. iii. 3. 4, *Doxogr. Graec.* 368) repeats this, but with a difference. He and Empedocles both regard lightning as the escape of *τὸ θερμόν* or *φῶς* which has been intercepted in the cloud. For the coming down as water cf. ib. iii. 4. 1 (*Doxogr. Graec.* 370) *Ἀναξιμένης νέφη μὲν γίνεσθαι παχυνθέντος ἐπὶ πλεῖον τοῦ ἀέρος, μᾶλλον δὲ ἐπισυναχθέντος ἐκθλίβεσθαι τοὺς ὄμβρους.*

61 a 6. **πλήν.** Lindau proposed to read *πάλιν* and St. approves this in his note. I agree with M. and A.-H. that such a change would be a corruption. There is no reason in what Timaeus says why the 'compressed' air should *not* be broken up *κατὰ τὸ στοιχεῖον* by particles of fire colliding with it, and we need the contrast between the action of fire on the 'compressed' and the 'uncompressed' air which the MSS. text provides.

61 a 7–b 6. **τὰ δὴ τῶν συμμείκτων . . . συμβέβηκεν.** We return to the application of the general principles just laid down to the case under actual consideration, that of the compounds of earth and water. *τὰ τῶν σ. σωμάτων* is a mere periphrasis for *τὰ σ. σώματα*, and should be the object-accusative with *εἴασεν*. Owing to the interposition of the *μέχριπερ . . . κατέχῃ* clause *τὸν ὅλον ὄγκον* is afterwards inserted as resumptive in the main sentence and the words which should properly express the object are left standing in an anticipatory apposition. In the case contemplated the interstices between the particles of earth are already so full of particles of water that no more water can get in if the body is immersed, and therefore it is insoluble. But particles of fire, being smaller, can get in and act on the water exactly as water does on earth, i. e. they can force its particles asunder, so that the mass (*ὄγκος*) dilates and begins to 'run' (*ῥεῖν*).

61 b 1. **καὶ βίᾳ συμπεπιλημένα,** *etsi violenter coarctata*, 'driven close together as they are'; i. e. what is being described takes place even though the particles of earth are already packed more than normally closely, unless the closeness of the packing reaches the point at which no *διάκενα* big enough to hold the icosahedra of water are left. It is not quite clear how we are to take the *αὐτοῦ*. It might be the adverb, 'on the spot', 'while there is water on the spot between the *διάκενα* of the earth', and I believe this to be right. A.-H. seems to regard the word as a genitive, in the sense of 'a body of this sort', used loosely where we should expect *αὐτῶν*. This is possible, but perhaps not quite so likely.

61 b 4–5. **ὅπερ ὕδωρ . . . ἀπεργαζόμενα.** I feel bound to adopt here a correction which recommended itself also to C. W., *ὅπερ ὕδωρ γῆν, τοῦτο πῦρ ὕδωρ* (for the *ἀέρα*) of the MSS. There is no reference to the action

of fire on *air* here. We are concerned with the special case of those 'compounds of earth and water' which can only be resolved by fire. The mere omission of ἀέρα (Schneider, Bt.) will hardly suffice, since πῦρ must be nominative, and we absolutely need an accusative of that on which the fire acts. A.-H. proposes to omit both πῦρ and ἀέρα urging that, as the words stand, there is nothing for ἀπεργαζόμενα to agree with. I cannot follow him here. The insertion of ὅπερ . . . ὕδωρ leaves the agreement of ἀπεργαζόμενα unaffected, πῦρ being in apposition with τὰ τοῦ πυρός. It would be contrary to all usage, as I think, not to state the ἀναλογία fully and formally. Fraccaroli follows A.-H.

61 b 6–c 2. τυγχάνει . . . συμπήγνυται. Two of the compounds of earth and water which are only soluble by fire are now mentioned, (*a*) ὕαλος, glass, and all 'stones which are fusible'; these have more earth in them than water; (*b*) wax, and spices and aromatic bodies generally, which have less earth than water (no doubt, because they are not equally hard). As M. says, the whole theory is ingenious, but rests on entire ignorance of the true chemical structure of the bodies in question. The real interest of this section of the dialogue is historical. It shows how the Pythagoreans of T.'s time could contrive to work together their own doctrine, which had begun by the 'one substance' view of the old Milesian type, only making the *res extensa* the primary body instead of air or water, with a biology based on the later doctrine of four irreducible 'roots'. The bridge over this apparently unbridgeable chasm is laid by regarding each 'root' as having one definite geometrical figure as the characteristic of its corpuscles, and then allowing corpuscles geometrically generated by the same triangle to pass into one another. Aristotle (?) agrees generally with T.'s view of the second class of compounds, *Meteorolog.* Δ. 388^{b} 31 λιβανωτὸς δὲ καὶ τὰ τοιαῦτα παραπλησίως τοῖς ξύλοις ἁπτίζει. ἐπεὶ οὖν τηκτά γε θετέον, καὶ ὅσα τήκεται ὑπὸ πυρός, ταῦτ' ἐστὶν ὑδατωδέστερα, ἔνια δὲ καὶ κοινά, οἷον κηρός. On the other hand, he regards ὕαλος as mainly composed of water, ib. 389^{a} 8, where ὕελος and λίθοι πολλοὶ ἀνώνυμοι are ranked with the metals on the ground that πάντα ταῦτα τήκεται θερμῷ.

61 c 3—64 a 1. καὶ τὰ μὲν δὴ σχήμασι . . . πυκνότητι παρέχεται. We now pass from the εἴδη or variations of the 'roots' dependent on their figures, combinations, and transformations to their παθήματα or attributes, i. e. the sensible qualities of bodies, colours, tones, tastes, and the rest. πάθημα means pretty much what was meant in older English by an 'affection' of a thing. In Plato πάθημα and πάθος are interchangeable (the forms παθημάτων and παθήμασιν in particular being specially common), and a πάθος of anything is whatever that thing πέπονθε. Now πέπονθε is a standing word to express the connexion between the subject of which attributes are asserted and the attributes asserted of it, from the point of view of the subject. (Cf. *Euthyphro* 10 c 1 εἴ τι γίγνεται ἢ τι πάσχει, οὐχ ὅτι γιγνόμενόν ἐστι γίγνεται, ἀλλ' ὅτι γίγνεται γιγνόμενόν ἐστιν· οὐδ' ὅτι πάσχον ἐστὶ πάσχει, ἀλλ' ὅτι πάσχει πάσχον ἐστί; ib. 11 a 6 καὶ κινδυνεύεις, ὦ Εὐθύφρων, ἐρωτώμενος τὸ ὅσιον ὅτι ποτ' ἔστιν, τὴν μὲν οὐσίαν μοι αὐτοῦ οὐ βούλεσθαι δηλῶσαι, πάθος δέ τι περὶ αὐτοῦ λέγειν, ὅτι πέπονθε τοῦτο τὸ ὅσιον; *Soph.* 245 b 7 πεπονθός τε γὰρ τὸ ὂν ἓν εἶναί πως οὐ ταὐτὸν

ὂν τῷ ἑνὶ φανεῖται, καὶ πλέονα δὴ τὰ πάντα ἑνὸς ἔσται; *Parm.* 139 e 8 τὸ ταὐτόν που πεπονθὸς ὅμοιον; 140 a 6 οὐδὲ μὴν ἕτερόν γε πέπονθεν εἶναι τὸ ἕν· καὶ γὰρ οὕτω πλείω ἂν πεπόνθοι εἶναι ἢ ἕν.) In fact, if we express a proposition as a 'function' of an 'argument', the 'argument' is regularly said in Greek πεπονθέναι the corresponding function. The πάθος which the subject is said πεπονθέναι may be anything whatever which can be asserted of it other than the οὐσία or τί ἔστι, the 'what is it?' which is called its ὅρος. We must not let ourselves be misled into seeing in the word any hint of the doctrine that the 'sensible qualities' of bodies are 'subjective affections of our sensibility'. This view was not that of any body of thinkers with whom Plato had any sympathy. The παθήματα to be spoken of are simply perceptible qualities. The reason why they cannot be dealt with fully at present is not that they are dependent on the *mind* of a percipient, but that to understand them you need to know how things interact with the tissues of his *body*, and up to the present we have said little about the structure of living bodies or even about that of 'what is mortal in the soul'. (This, as we shall see, means not αἴσθησις but θυμός and ἐπιθυμία; αἴσθησις, as we have already seen, is apparently ascribed to the soul before we come to its imprisonment in its house of flesh.) Consequently, in explaining what we mean by light and heavy, or soft and hard, we have to make reference to the ways in which foreign bodies affect our own and the physiological conditions in which such encounters evoke αἴσθησις. Since there has to be sensation if we are to recognize these qualities at all (ὑπάρχειν αἴσθησιν δεῖ τοῖς λεγομένοις ἀεί c 6 only means that the 'qualities' we are talking of have *to be* sensed, τοῖς λ. a *dativus commodi*), we are forced to adopt one of two makeshifts. Either we must *pro tempore* 'postulate' the existence of organic tissues and the occurrence of sensation until we have finished our account of sensible *qualities* and then go back to study the matters thus temporarily 'postulated' more accurately, or we may 'postulate' the sensible qualities as something known, proceed at once to sense-physiology and psychophysics, and then come back last of all to justify our initial postulates about sensible 'qualities' (Whitehead's 'sense-objects'). Timaeus holds that you are free, as you please, to begin with descriptive physics and go on to physiology and psychophysics, or to begin with these and go on to descriptive physics. But you may not begin at both ends at once. He proposes, for his own part, to begin with the descriptive physics and postpone the sense-physiology from reasons of *order*, 'that the account of the παθήματα of bodies may follow directly on the attempt at a classification of the bodies' (ἐξῆς λέγηται τοῖς γένεσιν.)

61 c 3. σχήμασι. St., Hermann, and the Zürich editors read σχήματα, apparently without MSS. support. The σχήμασι of AFY is, however, plainly the *lectio potior*, σχῆμα (shape of particle), κοινωνία (composition), and μεταλλαγή (transmutation) being just the three sources from which the endless variation in the *facies totius universi* has just been derived. εἴδη again means virtually here just 'bodies', exactly as when we find the εἴδη and γνῶμαι of men antithetically paired off against one another.

61 c 7. τῶν περὶ σάρκα. Since the 'skin' is represented at 76 a 1 as

a sort of 'scum' formed on the exposed surface of the flesh, perhaps it is specially the skin, which plays a very prominent part in connexion with *αἴσθησις*, that is meant here.

61 d 1. τὰ παθήματα ὅσα αἰσθητικά. The adjective has here not the commoner active signification, but the neutral sense 'connected with *αἴσθησις*', as was correctly explained by Boeckh. I cannot follow C. W. in holding that the *παθήματα* mean not characters of the various bodies themselves but effects produced by the bodies on a percipient (op. cit., p. 113). C. W. seems to me here to credit Timaeus with a 'bifurcation' of nature for which the text gives no justification. All through the *αἰσθητικὰ παθήματα* are treated as *παθήματα* of the bodies of which we commonly predicate them in everyday language. He is not maintaining that either our bodies or our minds play any part in making the 'sensible qualities', but merely explaining that it is only in the interaction between our bodies and others that we become aware of them.

61 d 5. ἔστω πρότερα ἡμῖν. I.e. we will treat the existence of the living organism and its connexion with a *ψυχή* as that which we *ὑποτιθέμεθα*, or ask to have for the present conceded. We shall examine the *συμβαίνοντα* of this postulate, and then shall afterwards return on the *ὑπόθεσις* itself and account for the existence of the various tissues of the living body by a theory of their composition out of the four 'roots'.[1]

61 d 5—62 b 6. πρῶτον μὲν . . . ἔσχεν ὄνομα. (*a*) The first pair of 'opposites' to be accounted for are *τὸ θερμὸν καὶ τὸ ψυχρόν*, i. e. temperature. This is put in the forefront, no doubt, because of the fundamental part played by temperature in both physics and physiology. Taking *τὸ θερμόν* first, we all perceive at once that a 'hot' body must be one which 'divides and cuts' our own (*τὴν διάκρισιν καὶ τομὴν αὐτοῦ περὶ τὸ σῶμα ἡμῶν ἐννοηθέντες*), for we feel its *πάθος* (its distinctive 'heat') as something *ὀξύ*, 'sharp', 'pricking'. T. is not arguing that the 'sharpness' is an 'effect' in the percipient and nothing more. He argues that in the sensation itself we directly become aware of what he holds to be the 'objective' fact that our flesh is being lacerated or pierced by the 'hot' body. This is as wholly 'objective' a process as the cutting of a loaf by a knife. Its occurrence is accounted for by reminding us of the angular shape, minute size, and high velocity our theory has assigned to fire. From our initial *ὑπόθεσις* about the shape, size, velocity of the particles of fire, this peculiar ability to lacerate the tissues of the body follows at once as a *συμβαῖνον*. The *πάθημα* which we call *θερμόν* is thus as strictly a *πάθος* of the particles of fire as the penetrating of a loaf is a *πάθος* of a bread-knife. In both cases, to explain fully the *πάθημα* of the knife or of the fire, we have to take into account what it does to a second body. The second body is not necessarily my own.

[1] This is the view taken of the meaning by Jowett and A.-H. in their translations. M. and Fraccaroli suppose that the meaning is 'let us first deal with *τὰ περὶ σῶμα καὶ ψυχὴν ὄντα*, i. e. with the *παθήματα*. This seems to me wrong. *τὰ περὶ σῶμα καὶ ψυχὴν ὄντα* is a periphrasis for *σῶμα καὶ ψυχή*. So *ἔστω πρότερα* must mean that we shall *presuppose* *ψυχή* and *σῶμα*, with a view to coming back to the subject later. That which one *ὑποτίθεται* is logically *πρότερον* to the *συμβαίνοντα* one deduces from it. We have not yet described the human *ψυχή* or *σῶμα*, but we are going to talk about the action of things on them as if they were 'known quantities'.

The fire divides a log of wood which it sets on fire exactly in the same way and for the same reason that it divides my flesh. Only it is due to the fact that I have a body and that my sensations are aroused in connexion with it that heat is a directly 'sensed' object. If I had no body, or none which the tetrahedra of fire could penetrate, fire would still be *θερμόν*, but its heat would no more be directly revealed to me by sense than the distinctive character of a magnetized iron bar is. It would be in the coals, but it would be something inferred, not felt.

62 a 4. ὃ νῦν θερμὸν λέγομεν. As M. observed, this is another sportive etymology. The suggestion is that *θερμός* is an altered form of an original **κερμός* with the sense of 'cutting small' (cf. *κέρμα*, *κερματίζειν*), connected with *κείρω*. (In point of fact the word represents an original **ghermos*, our *warm*.)

62 a 5–b 6. τὸ δ' ἐναντίον τούτων . . . ἔσχεν ὄνομα. The explanation of *τὸ ψυχρόν* follows; it is readily effected in terms of T.'s fundamental hypothesis without demanding the existence of a specifically 'cold' element with a particle of a particular structure. Hence Aristotle's objection that if *τὸ θερμόν* is accounted for by the shape of the tetrahedra of fire, *τὸ ψυχρόν* ought to be accounted for by particles of an 'opposite' shape, and that, as there is no relation of 'opposition' between figures, this invalidates the whole attempt to make the 'sensible qualities' of bodies functions of the shapes of their particles, is really singularly unintelligent. Yet Theophrastus thinks the objection good enough to repeat (*de Sensu* 87, *Doxogr. Graec.* 525 *ἄτοπον δὲ καὶ τοῦτο· πρῶτον μὲν τὸ μὴ πάντα ὁμοίως ἀποδοῦναι μηδὲ ὅσα τοῦ αὐτοῦ γένους. ὁρίσας γὰρ τὸ θερμὸν σχήματι τὸ ψυχρὸν οὐχ ὡσαύτως ἀπέδωκε*). On Aristotle's theory, both water and earth are 'cold' as opposed to the 'hot' bodies fire and air, but *fire* is *par excellence* the 'hot' element and water the cold. Timaeus holds that the particles of moisture from outside get into a body and force out the moisture already there, which has smaller particles. The new-coming particles cannot pack themselves into the same room as the smaller, but they push what is left of these into a smaller compass. Thus a condition of homogeneity and motionlessness supervenes on one of heterogenity and motion within the body, in fact, it undergoes partial solidification or freezing. The resistance to this solidification on the part of our own body gives rise to the movements we call shuddering and shivering (*τρόμος* and *ῥῖγος*). The *πάθος* of the body subjected to the process is called *ψυχρόν*, and the same name is given to the foreign body which induces such a state.

62 a 7 μεγαλομερέστερα εἰσιόντα. Here again the presence of *διάκενα* is presumed throughout.

62 b 6. τὸ δρῶν = τὸ ποιοῦν the agent. This use of *δρᾶν* for *ποιεῖν* is not common in Attic, except in the legal phrase *ὁ δράσας*, 'the perpetrator' of an act of criminal violence, but an increasing tendency to say *δρᾶν* where ordinary Attic writers say *ποιεῖν* is characteristic of Plato's latest style. The word belongs to the vocabulary of the Dorian dialects, and in Attic appears to be an old-fashioned word avoided by the stylists of the fourth century. (The *αὐτό* in *τὸ δρῶν αὐτό* is nominative, 'the agent itself'.)

62 b 6 . . . c 3. σκληρὸν δέ . . . μάλιστα. T. is dealing with the principal pairs of antithetical 'opposites' which played so prominent a part in Greek physical theory from Anaximander on. We have disposed of *ὑγρὸν . . . ξηρόν* in our account of the *ὑγρά* (58 d ff.) and of *θερμὸν . . . ψυχρόν* in 61 d 5—62 b 6. We come now to *σκληρὸν . . . μαλακόν*, the 'yielding' or 'elastic' and 'unyielding'. *τὸ μαλακόν* means that which 'yields' (*ὑπείκει*), what you can 'poke in', *τὸ σκληρόν* what does not yield. Timaeus particularizes a little further. *σκληρόν* is that to which our *flesh* yields, *μαλακόν* that which yields to our flesh. I. e. when you call things hard or soft without further qualification you mean hard and soft judged by this standard. He adds that things are hard and soft relatively to one another in the same fashion, i. e. *A* is hard relatively to *B* when, without being deformed itself it deforms *B*, and *B* is then soft relatively to *A*. (Thus lead is softer than iron because iron deforms lead, not lead iron.) Now things which stand on a small 'foot' (*βάσις*) yield most readily. (As we should say, they are in unstable equilibrium, since a very slight angular displacement will raise their centre of gravity.) Earth, whose particles rest on a square *βάσις*, has the figure which offers maximum resistance to displacement, and anything else whose structure is exceedingly close (*πυκνόν*), has the same character. (That is, not having much *κενόν* in it, it is relatively hard to displace.) This brings us back to the mistake already noted by M. of making the hardness of a body proportional to its density. In fact there is plainly a confusion of two different things, resistance to deformation in the direction of pressure and resistance to displacement of the centre of gravity. In practice, in modern times we measure 'hardness' in the following way, which amounts to a systematization of the view of Timaeus. A series of some half-score substances of degrees of sensible hardness ranging from very great softness to very great hardness is taken to form an arbitrary scale with talc at one end and diamond at the other. These are numbered from 1 to 10. The hardness of any other body is then said to lie between that of the highest member of this scale on which it will make a scratch and the lowest which will make a scratch on it. As A.-H. notes, Aristotle and Theophrastus define hardness and softness rather differently. T. identifies the 'soft' with the 'yielding'; they specify that it is that which yields 'in the direction of its depth'. Hence they both regard it as a defect of T.'s account, that with his definition water and air would be *μαλακά* because they do not resist deformation (are not 'rigid'). Aristotle and Theophrastus refuse to call them *μαλακά* because water and air do not yield to pressure in the direction of their depth (are not readily compressible). The air or water which gives way before your finger only moves round and closes up behind it by the motion of *περίωσις* or *ἀντιπερίστασις*. The difference on this point is not *merely* one of 'words' (A.-H.). Aristotle and Theophrastus *mean* to say that the real difference between things which feel soft to the touch and those which feel hard, is that the former are readily *compressible*. (They knew nothing experimentally of compressed air, and they were *nearly* right in thinking water incompressible.) Cf. Aristotle *De Caelo* Γ. 299^{b} 13 *μαλακὸν μὲν γὰρ τὸ εἰς ἑαυτὸ ὑπεῖκον, σκληρὸν δὲ τὸ μὴ ὑπεῖκον.* T. is in error when

he goes on to correlate hardness directly with density, as we see from the case of gold and iron.

62 c 3—63 e 8. βαρὺ δὲ καὶ κοῦφον . . . ταῦτα αἴτια εἰρήσθω. We now come to a third pair of 'opposites', heavy and light. The treatment of weight requires very careful study. No Greek theorist down to the time of Aristotle made weight a primary consideration in his account of the universe. No one had explained the motion of bodies by any inherent tendency to 'fall' in a particular direction. This is true even of the Atomists, who appear to have said nothing about the movements of atoms not already caught in a cosmic *δίνη*, and to have explained the tendency, within the *δίνη*, for the bulkier atoms to find their way to the centre as a consequence of their greater power of retaining whatever original motion they happened to have. In the third century Epicurus made the weight of atoms the cause of their original motions, and consequently assumed that in the *κενόν* they all fall in parallel straight lines 'down' with a uniform velocity. This has the implication that there is a fixed direction 'down', which is the same for atoms falling freely in all regions of the universe, in fact that all atoms are falling with equal velocity in lines perpendicular to a fixed plane in 'absolute' space. Such a theory makes the origination of a *κόσμος* impossible, unless it is relaxed, as Epicurus relaxed it, by allowing incalculable infinitesimal *παρεγκλίσεις* or *clinamina* from the line of descent, and ought to have been a peculiarly impossible doctrine for Epicurus, who revived the old notion of 'innumerable *κόσμοι*'. In fact, Aristotle makes it a chief argument against the plurality of *κόσμοι* that a direction 'up' or 'away from the centre' of one *κόσμος* would be a direction 'down'; or 'towards the centre' of a second, so that e. g. earth, if there are more *κόσμοι* than one, cannot be said to fall unambiguously 'down'; its movement will be just as truly 'up' as 'down', whereas Aristotle regarded it as a fact of primary importance that earth is unambiguously 'heavy' and has a proper motion 'towards the centre', fire is light and its proper motion is 'away from the centre' (*de Caelo* A. 276ª 18–276ᵇ 18). That Leucippus and Democritus knew nothing of the alleged 'downward' motion of the atom seems beyond doubt. Aristotle says expressly that D. held that the weight of an atom is directly proportional to its bulk (*de Generat.* A. 326ª 9 = R. P. 199 a) *βαρύτερόν γε κατὰ τὴν ὑπεροχήν φησιν εἶναι Δημόκριτος ἕκαστον τῶν ἀδιαιρέτων*) and Theophrastus (*de Sensu* 61, *Doxogr. Graec.* 516 = R. P. 199) *βαρὺ μὲν οὖν καὶ κοῦφον τῷ μεγέθει διαιρεῖ Δημόκριτος*, and Aristotle that he had never explained what the 'natural' movement of the atom is (*de Caelo* Γ. 300ᵇ 8 = R. P. 195 *διὸ καὶ Λευκίππῳ καὶ Δημοκρίτῳ, τοῖς λέγουσιν ἀεὶ κινεῖσθαι τὰ πρῶτα σώματα ἐν τῷ κενῷ καὶ τῷ ἀπείρῳ, λεκτέον τίνα κίνησιν καὶ τίς ἡ κατὰ φύσιν αὐτῶν κίνησις*, cf. Aristotle *Physic.* Θ. 252ª 32 = R. P. 195 a). Since Epicurus arbitrarily assumed that all bodies would move with the same velocity in the *κενόν*, on his own principles the *relative* positions of his atoms would never change and a world could never be formed out of them. To meet this difficulty he introduced the theory of the *παρέγκλισις* or *clinamen principiorum*, according to which the atom swerves a little from the true line of descent at unforeseeable times and from no particular cause (Usener *Epicurea*, pp. 199–201). Cf. Lucretius ii. 216 ff.:

illud in his quoque te rebus cognoscere avemus,
corpora cum deorsum rectum per inane feruntur
ponderibus propriis, incerto tempore ferme
incertisque locis spatio decellere paullum,
tantum quod momen mutatum dicere possis.

Presumably this theory, for which no proof is offered except that animals have a free will of pure caprice (Lucret. ii. 256 'libera per terras unde haec animantibus exstat, | unde est haec, inquam, fatis avulsa potestas | per quam progredimur quo ducit quemque voluntas?'), was devised under Aristotelian influences to adopt the Atomist doctrines to the theory of an absolute 'up' and 'down', a notion only really intelligible if we keep, like Aristotle, to a single *οὐρανός* with the earth at its centre. Aristotle is thus morally responsible for the whole subsequent secular confusion of ideas about weight. Adopting Plato's preference for a single *οὐρανός*, he evades the blunder of putting an earth at rest in 'absolute space' at its centre. 'Up' now means in the direction along any radius of this *οὐρανός* from its centre to its circumference, 'down' direction along a radius from circumference to centre. (Ar. is aware therefore, that up and down at different places on the earth's surface are different directions.) Ar. then insists that two of the four 'simple bodies', earth and fire, if left to themselves move 'down', i. e. 'towards the centre' and 'up', 'away from the centre' respectively. Consequently earth is absolutely 'heavy', fire absolutely 'light'. As for the other two, water is *relatively* heavy, because, left to itself, it moves 'down' until it is in contact with the region of earth, air is relatively light, because, left to itself, it moves 'up' until it reaches the region next 'below' that of fire. See *de Caelo* Δ. 311[a] 16 *πρῶτον μὲν οὖν διωρίσθω, καθάπερ φαίνεται πᾶσι, βαρὺ μὲν ἁπλῶς* (absolutely) *τὸ πᾶσιν ὑφιστάμενον, κοῦφον δὲ τὸ πᾶσιν ἐπιπολάζον. ἁπλῶς δὲ λέγω εἴς τε τὸ γένος βλέπων, καὶ ὅσοις μὴ ἀμφότερα ὑπάρχει· . . . ἄλλως δὲ βαρὺ καὶ κοῦφον, οἷς ἀμφότερα ὑπάρχει· καὶ γὰρ ἐπιπολάζουσί τισι καὶ ὑφίστανται, καθάπερ ἀὴρ καὶ ὕδωρ κτλ.* In other words when we call 'fire' 'light', we do not mean simply, as we do on Timaeus' view or that of our own day, that it is *not* so *heavy* as something else (e. g. not so heavy as water or wood or stone). Fire is not heavy *at all*; its lightness is no more the lack of weight than the whiteness of snow is the lack of black. Indeed, Aristotle sometimes uses arguments which imply the paradox that, no volume of air, however great, could weigh anything at all.[1] E. g. *de Caelo* Δ. 308[b] 27 *ἀεί τε γὰρ ὁ πλείων ἀὴρ ἄνω*

[1] This is not inconsistent with his doctrine that air is only relatively light, and therefore also relatively heavy. For he only means that air, though it will mount above the region of water, will not mount into that of fire. Air detained 'below' its 'proper region' will always, if unimpeded, ascend to that region, whereas water will not ascend beyond its own region. Hence he thinks it absurd to say that any volume of air whatever can be as heavy as a given volume of water. His argument is that 'the more there is of it, the faster it rises'. Apparently the reasoning is that even a small quantity of air will make its way up, if set free, from the bottom of a large body of water, and therefore must be 'lighter' than the whole volume of the water. It is forgotten that all that is proved is that the air is lighter than its own bulk of water.

φέρεται μᾶλλον, καὶ ὅλως ὁτιοῦν μέρος ἀέρος ἄνω φέρεται ἐκ τοῦ ὕδατος. (This is meant as a refutation of Timaeus, who has just been reproached for holding that 'there can be some volume of air which is heavier than water', and the context shows that this means only 'heavier than *some* volume of water', loc. cit. [b] 25 ἔσται τι πλῆθος ἀέρος ὃ βαρύτερον ὕδατος ἔσται.) The 'celestial body' of which the 'spheres' are made is then supposed to have neither weight nor lightness, as it moves neither 'down' nor 'up' but round and round.

Plato's theory—or that of Timaeus—is the best worked out which the Greeks have left us. It makes weight, as it really is, a secondary thing, and assumes that the weight of any body depends on its position relative to others. A true theory could not have been worked out in the absence of the all-important conception of *mass* as a natural invariant. (If I were transported to Venus or Mars I should weigh much lighter than I do, if to the sun, much heavier, because the gravitational 'pull' on me would be so much decreased in the first case and so much increased in the second, but the mass of my body would not be affected by the change of position.) The superiority of the *Timaeus* over Aristotle in its account of τὸ βαρύ and τὸ κοῦφον is just that it recognizes that there is no absolute weight or lightness, and consequently no division of bodies into 'heavy' ones with a natural motion in one sense, and 'light' ones with a natural movement in the opposite sense. Even to-day this is sometimes forgotten. I have found it given as an instance of something 'absolute' in nature that the weight of a book is the same in my hand as on the shelf.

62a c 5–d 4. φύσει γὰρ δή . . . πάντων εἶναι. If we are to think clearly about weight, we must begin by correcting a popular error about 'up' and 'down'. The popular belief (based on the unconscious assumption that the earth is a flat disk) is that there are two sharply contrasted regions 'above' and 'below', and that all bodies whatever (πανθ' ὅσα τινὰ ὄγκον σώματος ἔχει) left to themselves fall down; nobody rises 'up' except 'under compulsion' (ἀκουσίως); i. e. to raise it you have to overcome its resistance, 'to do work against gravity'. T. does not credit any one with being so deluded as to maintain, as Aristotle did, that some bodies spontaneously move 'up'. To correct the misconception, we have only to remember that the οὐρανός is finite and spherical. All points on the circumference are equally removed from the centre and 'similarly' (ὁμοίως) situated with respect to it; the centre may therefore be said to be καταντικρύ 'opposite' each and all of them. Consequently the direction out from the centre along any radius is no more nor less 'up', nor that in from circumference to centre along any radius more or less 'down', than the direction along any other. Strictly we ought not to use the words up and down at all, but to speak simply of the contrasted senses of movement along any radius as 'to the centre' and 'away from the centre'.

This is not a new discovery of Plato. Anaximander had taught the same thing, not of course about his 'boundless body', but about our οὐρανός, and had very properly given as the reason why the earth does not 'fall' from its central position its ἰσορροπία or 'equipoise', the fact that it is equally far from the circumference of the οὐρανός in every direction

(R. P. 20 = Hippolytus *Refut. Haeres.* i. 6, *Doxogr. Graec.* 559 *τὴν δὲ γῆν εἶναι μετέωρον ὑπὸ μηδενὸς κρατουμένην, μένουσαν δὲ διὰ τὴν ὁμοίαν πάντων ἀπόστασιν*). This sound idea had passed, with much else, from Anaximander to the Pythagoreans, as we see from the use made of it in the myth of the *Phaedo*, where the source of Socrates' inspiration is, as is generally recognized, Pythagorean (*Phaedo* 109 a 2 *ἱκανὴν εἶναι αὐτὴν ἴσχειν τὴν ὁμοιότητα τοῦ οὐρανοῦ αὐτοῦ ἑαυτῷ πάντῃ καὶ τῆς γῆς αὐτῆς τὴν ἰσορροπίαν· ἰσόρροπον γὰρ πρᾶγμα ὁμοίου τινὸς ἐν μέσῳ τεθὲν οὐχ ἕξει μᾶλλον οὐδ' ἧττον οὐδαμόσε κλιθῆναι, ὁμοίως δ' ἔχον ἀκλινὲς μενεῖ*).

62 d 3. ἐν τῷ καταντικρύ. The only point you can intelligibly describe as 'opposite' a point on the circumference is the centre, and this 'faces' all points on the circumference alike, and may be said to be 'opposite' any one with as much reason as it can be called 'opposite' any other.

62 d 6–8. ὁ μὲν γὰρ μέσος ... ἐν μέσῳ. So far Timaeus had said nothing with which Aristotle would not agree. It is in this sentence that he shows his superior capacity for scientific thinking. Aristotle identifies the *ἄνω* and *κάτω* of popular language with the directions at any spot along a common radius of the earth and *κόσμος* outwards towards the circumference and inwards to the centre. Hence he observes more than once that the 'vertical' or plumb line, perpendicular to the horizon, is different at different points, and that heavy bodies, falling at different places, do not fall in parallel lines, but in lines vertical to the horizon at the place of descent (*de Caelo* B. 296^{b} 19 *τὰ φερόμενα βάρη ἐπὶ ταύτην οὐ παρ' ἄλληλα φέρεται ἀλλὰ πρὸς ὁμοίας γωνίας*, 297^{b} 18 *πάντα φέρεται τὰ βαρέα πρὸς τὰς ὁμοίας γωνίας*, ib. Δ. 311^{b} 33). But T. rightly goes on to object to the very use of the words 'up' and 'down' in scientific discourses. We should rather say simply that the 'centre' is not 'below' but just 'at the centre'. The *αὐτό* with *ἐν μέσῳ* is used as an indeclinable, and in fact an adverb, qualifying *ἐν μέσῳ*, just as the same word is used as an indeclinable adjective in combinations like *αὐτὸ δικαιοσύνη*, '*just* in the middle'. In d 10 the *ἤ* does not mean 'than', but 'or'.[1] Tr. 'and the circumference again is, of course, not in the middle, nor does any part of it differ in any way from any other relatively to the middle or to anything "opposite" itself'. In effect, though not *totidem verbis* this amounts to saying that the only point that can be distinctively called 'opposite' to a point on the circumference is the centre, and this is equally 'opposite' to all points on the circumference.

63 a 1. ἰσοπαλές. Equivalent in sense to *ἰσόρροπος*. The word is an echo of Parmenides' description of *τὸ ἐόν* as a sphere which is *μέσσοθεν ἰσοπαλὲς πάντῃ*, 'equally balanced in every direction about its centre'. The reflection that a symmetrical body balanced at the 'centre' would not fall in any direction is a reminiscence of Anaximander.

63 a 2–4. ἀλλ' εἰ ... προσείποι. T. illustrates the point further by supposing a spherical body poised at the 'centre' so that every point of its surface is equally distant from the spherical boundary of the *οὐρανός* (like the earth in the myth of the *Phaedo* or in the cosmology of Aristotle). That he speaks of this body as though he were merely imagining it, should confirm our view that he does not himself believe the earth to be

[1] This is also correctly pointed out by Fraccaroli.

really occupying such a position. If a man walked round such a sphere, he would 'many a time be antipodal to himself, and so call the same direction up and down' at different times. That is, when his feet are at *A*, an extremity of the diameter *A'A*, and his head at *B*, on *A'A* 'produced', he calls the direction *AB* from his feet to his head 'up', and the direction *BA* 'down'. But when he has gone 180° and reached the other end of the diameter, it will be *BA* which he will call 'up' and *AB* which he will call 'down'. By the time the circuit has been completed *every* direction will have been called 'up' and also 'down'.

περὶ αὐτό means round the *outer* circumference of the supposed body at the centre of the *οὐρανός*, in fact, round such an earth as is described in the myth of the *Phaedo*. A.-H. supposes it to mean round the inner surface of the sky, but this must be wrong. If the man were supposed to walk round the inside of a huge ball fly-fashion, there would be no need to introduce the body 'at the centre' into the illustration; it is put in to give him something to stand on. And grammatically the *αὐτό* has nothing to refer to but the *στερεὸν κατὰ μέσον τοῦ παντός*. (St. had explained the point quite correctly.)

63 a 6–b 1. ὅθεν δὲ . . . ὑποθεμένοις τάδε ἡμῖν. Timaeus next goes on to explain how the error of believing in an absolute 'up' and 'down' has arisen. 'Whence these names have been borrowed and what are the subjects to which they really belong, by transference from which we have accustomed ourselves to apply this division (the division into an "above" and a "below") to the *οὐρανός* as a whole (*ἐν οἷς ὄντα εἰθίσμεθα δι' ἐκεῖνα καὶ τὸν οὐρανὸν ὅλον οὕτω διαιρούμενοι λέγειν*), must be settled by the following convention.' (That is, we come to a convention, an agreement between ourselves on a preliminary point; the making of this convention or *ὑπόθεσις* will enable us to understand the nature of the mistake committed by the believers in an absolute 'up' and 'down'.) *ὑποθεμένοις* has its full primary force, 'we must agree on the following point as a point of departure' for the explanation which is to follow. The *ὁμολογία* provides us with that common ground which is presupposed in all argument. To render e.g. 'by this hypothesis' would be misleading. A man's *ὑπόθεσις* in the language of the fifth century is just what he regards as most unhypothetical, the initial postulate or set of postulates which he expects you to concede for argument's sake before he proceeds to develop his views further. This is why the Hippocratean *Περὶ ἀρχαίης ἰητρικῆς*, an essay in support of the view that medicine should be pursued as a wholly experimental science, apart from cosmological speculations, gives the name *ὑποθέσεις* to the doctrines of the various cosmologists about the primary body, or bodies; 1 *ὁπόσοι μὲν ἐπεχείρησαν περὶ ἰητρικῆς λέγειν ἢ γράφειν, ὑπόθεσιν αὐτοὶ αὑτοῖς ὑποθέμενοι τῷ λόγῳ θερμὸν ἢ ψυχρὸν ἢ ὑγρὸν ἢ ξηρὸν ἢ ἄλλο τι ὃ ἂν θέλωσιν, ἐς βραχὺ ἄγοντες τὴν ἀρχὴν τῆς αἰτίης τοῖσιν ἀνθρώποισι νούσων τε καὶ θανάτου, καὶ πᾶσι τὴν αὐτήν, ἓν ἢ δύο ὑποθέμενοι, ἐν πολλοῖσι μὲν καὶ⟨νοῖσι⟩ οἷσι λέγουσι καταφανέες εἰσὶ ἁμαρτάνοντες . . . διὸ οὐκ ἠξίουν αὐτὴν ἐγὼ καινῆς ὑποθέσιος δεῖσθαι κτλ.*; 13 *ἐπὶ δὲ τῶν τὸν καινὸν τρόπον τὴν τέχνην ζητεύντων ἐξ ὑποθέσιος τὸν λόγον ἐπανελθεῖν βούλομαι*; 15 *ἀπορέω δ' ἔγωγε, οἱ τὸν λόγον ἐκεῖνον λέγοντες*

καὶ ἄγοντες ἐκ ταύτης τῆς ὁδοῦ ἐπὶ ὑπόθεσιν τὴν τέχνην τίνα ποτὲ τρόπον θεραπεύουσι τοὺς ἀνθρώπους, ὥσπερ ὑποτίθενται.

63 b 2–c 5. *εἴ τις . . . καὶ ἄνω.* The preliminary point on which we need to agree is now explained. Suppose a man were in that part of the *οὐρανός* where there is the main great cosmic mass of fire, towards which other fire tends to move, so far as it is left free to do so, in virtue of the principle of 'like to like', i. e. in consequence of that tendency of random motion to end in a sorting out of like with like about which we heard at 52 e—53 a. That is, suppose a man was in the region where the stars (which are in the main 'fire', 40 a 2) are, and were endowed with the requisite mechanical powers, and were to weigh portions of the fire there in a pair of scales, erecting them in such a way that the scales themselves were outside the region of fire and within that of air, so that any bulk of fire placed in one of the scales would be detached from the cosmic mass of fire and 'lifted' into an 'unlike' region. In the experiment, the scales themselves are supposed to hang clear of the 'region of fire', so that we must suppose the proceedings to take place at the border between the regions of fire and of air. If a man did this, plainly he would need less force to overcome the resistance of a smaller quantity of fire. Fire would resist the attempt to interfere with its natural tendency to drift to the 'region of fire', and the more fire you hinder from drifting, the more force you will have to exert. (*βιᾶται*, c 1, is clearly passive, not middle. The very reason for changing the verb, *βιαζόμενος–βιᾶται*, is that *βιάζεσθαι* has just been used as a middle, and that it would be ambiguous to use it immediately as a passive. The use of *βιᾶσθαι* as passive seems not to occur elsewhere in Attic, but it is Ionic prose style—see the examples in L. and S.—and Ionic, not Attic, was the language of fifth-century Pythagoreans. There are plenty of Ionicisms in T.'s discourse, some of which must be intentional. As to the tense, Veitch's suggestion (*Greek Verbs*, s. v.) that it is an 'Attic future' is very attractive. The future is the tense one naturally expects in the apodosis of a conditional sentence of this type.) The point then is that, as we should say, the 'attraction' of the cosmic mass of fire would be greater on a greater than on a smaller portion which one was trying to detach, and more force would therefore have to be used in overcoming it. (Note the assumption that weight is to be accounted for as the result of an 'attraction' of some kind.) The scale pan with more fire in it would be further 'depressed' in the direction of the cosmic mass of fire than that with less. The man performing the experiment is supposed to be in the 'region of fire', and he would express these facts by saying that the greater bulk tends to sink *downwards* to the place where he himself is. By 'down' he would mean in the direction of the region where his feet are planted. Similarly he would say that the smaller quantity of fire is 'light' and that the scale containing it tends to 'rise' out of the region of fire 'up' into that beyond his head, the region of air. (If once we remember that the man's feet are supposed to be well in the region of fire and his head to be nearer, if not over, the boundary between fire and air [b 4 *ἐπεμβὰς ἐπ' ἐκεῖνο*] all this is obvious.)

63 c 5–d 4. *ταὐτὸν δὴ τοῦτο . . . καὶ κάτω.* Now transfer this to our

own case. *We* stand (c 7 βεβῶτες, A.-H.'s rendering 'move' is wrong) on the *earth*, and when we weigh bodies what we do is this.[1] We are putting into our scales things made of earth or samples of earth itself detached from the main mass (γεώδη γένη καὶ γῆν ἐνίοτε αὐτήν), and lifting them in the direction of the alien region of air. (Here again we have the correct perception that it is what we call the 'gravitational attraction' of the earth which is responsible for weight.) Now our scales are hanging in the air and the solid bodies we weigh in them have been transported into the region of air. Their natural tendency is to rejoin the mass of earth. Hence it takes effort to lift them, and the more of such a body there is, the greater is the effort needed, and the farther that body will depress the pan of the balance. (At bottom the whole theory of the lever is involved in this perception, but we must not credit Timaeus with the full recognition of the principle. So far as we know, no one in the ancient world before the great Archimedes had any clear views about levers at all.) Thus we see that the case of the supposed man weighing fire 'in the region of air' is really our own case, only that what we weigh 'in the region of air' is earth.

63 d 4–e 8. ταῦτ' οὖν . . . εἰρήσθω. We are now in a position to formulate the general principle implied in the two cases just examined. We see that what is 'light'—easy to dislodge—in one region is 'heavy', hard to dislodge in another. Anything is easy to dislodge from an 'alien' region in the direction of its own, and the more there is of it, the less effort is required for its expulsion. Anything is hard to dislodge from its own proper region, and the more there is of it, the harder the task is. And by what is 'light' or 'heavy' in a given region we mean what is easy, or hard, to dislodge. Consequently, since 'down' means in ordinary parlance the direction in which 'heavy bodies' fall, and 'up' the opposite direction, 'up' and 'down' are also purely relative terms. We now see exactly what this pair of terms means. 'Up' is the direction counter to the tendency of bodies of one kind to congregate in a cosmic mass, 'down' is the direction of this tendency itself. Hence to us, who live on the earth, 'down' means towards the earth and 'up' means away from it. But if we lived in the region of fire 'down' would mean towards *that* region and 'up' away from *it*. So the terms 'up' and 'down' are purely relative to the position of the observer who uses them. For example, we should think of Jules Verne's adventurers as shot *up* to the moon, but the 'man in the moon' would think of them as *descending* on his planet.) It must be most carefully noted therefore that Timaeus does not, like Aristotle, identify 'down' with the direction of the centre of things and 'up' with the direction away from the centre. We have already been told that the *only* proper names for these directions are 'to the centre' and 'from the centre'. It follows, then, that light and heavy are purely relative terms too. That is heavy which it is hard to shift into a foreign region, that light which it is easy to shift. Hence we, who

[1] διιστάμενοι in 63 c 7 of course means 'weighing', the force of the δια- being that you put the weights into one scale, the body weighed into the other, and so balance the two 'earthy bodies' against one another. Translators, except Fraccaroli, wrongly render 'separating'.

live on the earth, call earth heavier than fire or air, and a big stone heavier than a small one. But if we lived in the region of fire we should fined it much easier to expel earth from our neighbourhood than fire, and easier—it is assumed—to expel a big stone than a small one. So we should then call fire heavier than earth and, I suppose, a small stone heavier than a large one. The key to the whole doctrine is to understand that to an observer anywhere in the universe 'up' means out of his own 'region' into the adjacent region. (Timaeus, however, might have found it a little harder to decide exactly which direction is 'up' to a dweller in air or water.)

63 e 2. καὶ πλάγια, 'athwart', 'inclined', as opposed to vertical up or down motion. It would be possible under the definition that the direction which *A*, from his point of view, calls 'up' should neither coincide with *B's* 'up', nor be what *B* calls 'down', but should make an angle with *B's* vertical, just as on earth the direction which is vertical for London, makes an angle with that which is vertical for Paris or Vienna or New York. T.'s remarks will gain in 'actuality' if we remember the evidence we produced to show that he seriously regards the planets as all inhabited by *ζῷα λογικὰ θνητά*.

It will be seen that the theory of *βαρύ* and *κοῦφον* ascribed to T. is completely logical, and is really in the true line of thought which ultimately leads to our modern notions about gravitation, though no genuine theory of gravitation can be worked out without the notion of *mass*, which was introduced to the world in 1687 in Newton's *Principia*. But Pythagorean and Academic science was moving as directly in the *direction* of Galileo and Newton as in that of Copernicus and Kepler, and it is a tragedy of the human intellect that Aristotle and the Stoics, with their crude Ionian prepossessions, were able to arrest the tendency as thoroughly as they did.

Plato's exposition must be carefully distinguished from the theory of weight which Aristotle forced on science very much to its detriment. The two agree only on one point, viz., that the great cosmic aggregates of the 'roots' have their own proper regions, and that matter out of its 'region' tends to move thither. The differences are (1) Plato is careful to make Timaeus distinguish between the terms 'up' and 'down' and the terms 'away from the centre' and 'towards the centre'; Aristotle identifies 'down' with 'towards the centre' and 'up' with 'away from the centre'. Hence Plato's account of 'up' and 'down' still applies if you believe in an infinitely extended universe; Aristotle's account is unmeaning except on the supposition that there is one finite 'world' with the earth at its centre. (2) Plato accounts for the movement of each kind of body to its proper region by supposing that fire is 'attracted' to the great cosmic mass of fire, earth to that of earth, and so on; Aristotle made the motion not one towards the appropriate aggregate of body but to a certain 'region' in absolute space. Hence his singular theory of the absolute lightness of fire. The theory is, in fact, that this 'element' tends to rise in virtue of its own mass. Thus the idea of 'gravitational attraction' was for centuries expelled from natural philosophy.

Aristotle has attempted an unfavourable criticism of the theory of

weight given in the *Timaeus*, and it is also attacked at some length by Theophrastus in the Fragment *de Sensu*. Aristotle's criticisms are given at *de Caelo* Δ. 308^{b} 3. 'Some treat of lightness and weight in the way in which it is written (τυγχάνει γεγραμμένον) in the *Timaeus*. They hold that a body composed of a greater number of the same constituents (ἐκ πλειόνων τῶν αὐτῶν) is heavier, one composed of fewer (ἐξ ἐλαττόνων) lighter . . . a thing being heavier in virtue of a greater number of equal parts. In the same way too, they say, lead is heavier than wood. For all bodies are formed of certain identical constituents (ἔκ τινων τῶν αὐτῶν) and of one material (μιᾶς ὕλης), though it seems otherwise. But these distinctions take no account of *absolute* weight and lightness (οὕτω δὴ διωρισμένων οὐκ εἴρηται περὶ τοῦ ἁπλῶς κούφου καὶ βαρέος). In point of fact fire is always light and always moves up, earth and all earthy bodies always move down, i.e. towards the centre. Hence it is not because of the fewness of the triangles of which they say a thing is composed that fire has a natural upward motion (ἄνω φέρεσθαι πέφυκεν). If that were so, a larger volume of fire would move less and would be heavier, since it contains more triangles (ἧττον ἂν ἐφέρετο καὶ βαρύτερον ἂν ἦν ἐκ πλειόνων ὂν τριγώνων). But what we actually see is the opposite of this; the more fire there is, the lighter it is, and the more rapidly it moves upward (ὅσῳ γὰρ ἂν ᾖ πλεῖον, κουφότερόν ἐστι καὶ ἄνω φέρεται θᾶττον). And so, too, a small quantity of fire will be carried downward faster, a larger quantity more slowly. Besides, since on this view what has fewer of the homogeneous parts (τὸ μὲν ἐλάσσω ἔχον τὰ ὁμογενῆ) is lighter, what has more, heavier, and air, water, and fire are all composed of the same triangles, the only difference being in the number of them (ἀλλὰ διαφέρειν ὀλιγότητι καὶ πλήθει)—this being why one of these (elements) is lighter or heavier than another, there will be *some* volume of air which is heavier than water (ἔσται τι πλῆθος ἀέρος ὃ βαρύτερον ὕδατος ἔσται). But what actually happens is clean contrary (συμβαίνει δὲ πᾶν τοὐναντίον). A greater quantity of air always rises more (ἀεί τε γὰρ ὁ πλείων ἀὴρ ἄνω φέρεται μᾶλλον), and any portion of air, however small (ὁτιοῦν ἀέρος μέρος), rises from water.' This criticism shows Aristotle at his very worst. He actually maintains that no volume of air can be as heavy as the smallest volume of water, and makes it an objection to Timaeus that he ascribes weight to all bodies. His other point is that the greater the volume of imprisoned air or fire, the greater is the rush with which it escapes. From this he intends it to be inferred by analogy that a larger stone will fall from a given height faster than a smaller one. (This is the teaching of the *Physics*, though, as we know, it is, in fact, false.) The point he means to make against Timaeus is that when e.g. stones fall from a great height, the greater mass of stone is more easily dislodged from the 'region of air', and should therefore, with the definitions of Timaeus, be pronounced lighter than a smaller mass, but that this is contrary to common sense. Now this is not a fair point. It depends on ignoring that pure relativity of the notions 'light' and 'heavy' on which the definitions of Timaeus insist. T. does not deny that it is easier to dislodge a big stone from the region of air than a small one. (It is possible that he shared Aristotle's belief that the big stone falls faster than the small one.)

His point is that the facts which lead *us* to call the big stone the heavier would be a reason why an *air-dweller* should call it the lighter. His definition was, 'that is heavy—relatively to its own region—which it is hard to dislodge'. Aristotle's counter-examples are both taken from a process of removing something not from its *own*, but from an alien, region. Hence they have no relevance against Timaeus. They only show that Aristotle could not or would not understand that weight is relative to a given 'region', or, as we should say, to the situation of a body in a given gravitational field. The whole polemic against the *Timaeus* is thus a mere petitio principii, as it turns on assuming those notions of absolute weight and lightness which Timaeus rightly dismisses as unmeaning. The plain truth is that, with all Aristotle's eminence in zoology and biology, the unmathematical cast of his mind makes him about the *worst* of physicists. When he discusses a subject where his own early training stands him in stead, such as the physiology or the sense-psychology of the dialogue, his criticisms are on a very different level.

The criticism of Theophrastus is to be found in *de Sensu* 88–9 (*Doxogr. Graec.* 526). Another text of the passage with English version and notes will be found in G. M. Stratton, *Greek Physiological Psychology*, London, 1917. In the commentary in Professor Stratton's volume there is also included a rendering of the passage by myself with a detailed discussion of its meaning. There is a disagreement between Professor Stratton and myself about the text and interpretation of one clause, and I do not now feel confident that Professor Stratton was not right on the point in dispute. Fortunately it does not seriously affect the main argument, so I venture to reproduce here my own rendering of the sections.

'He has defined heavy and light not universally, but for the special case of earthy bodies (οὐχ ἁπλῶς, ἀλλ' ἐπὶ τῶν γεωδῶν). For it is generally held that of them the heavy is difficult, the light easy, to remove to a foreign region. But fire and air are held to be, and really are, light in virtue of their motions *to* their proper regions. Hence it will not be true that what contains fewer homogeneous parts is always heavy, and what contains more, light. [Professor Stratton follows Philippson in transposing the words "heavy" and "light" in this sentence. I have followed Diels in regarding the MSS. reading as correct, and have attempted to explain it in my note on the passage in Professor Stratton's *Commentary*.] Fire is, indeed, lighter the more there is of it, but if the fire is placed "on high", both the statements will be applicable, if it is placed here on earth, neither. It is the same with earth, for the greater volume will descend more rapidly from "on high". Thus earth and fire are not [i. e. are not by the account of Timaeus] absolutely heavy and light respectively, but each with reference to the region. And earth does not behave alike "here" and "there" [1], but in opposite ways. For "here" it is that which contains fewer, "there" that which contains more, of the homogeneous parts which is lighter.' I may quote the following remarks from my notes on the passage:

'The *main* point is that Plato's definitions make *heavy* and *light* purely

[1] Accepting from Diels the correction of ἐνταῦθα καὶ to ἐνταῦθα κἀκεῖ.

relative to the standpoint of the observer. . . . *We* call air light because it escapes readily from the surface of the earth, and stones heavy because it takes an effort to throw them into the air and they fall back again. An observer placed in the upper atmosphere high above the earth's surface would . . . call stones light because it requires no effort to expel a stone from that region, and air heavy because you couldn't easily expel it. Aristotle and Theophrastus object that in their opinion light and heavy are absolute terms. Light is what tends to mount, heavy what tends to sink. The whole criticism turns on their belief that up and down are fixed directions in absolute space. . . . But Plato is wrong (i. e. according to Theophrastus) in giving a definition from which it would follow that, from an assumed position in the upper sky or among the stars, fire could be correctly described as heavy. . . . It is true that fire would be as hard to expel from its region as earth from its, but, for all that, fire is *light*, because it tends to move "away from the centre"; there is *no* standpoint with reference to which it can be called heavy. . . . The main point to be clear on is that from the Aristotelian point of view you must not say at all that one stone is light and another heavy, but only that the one is not so heavy as the other. Earth is always heavy, no matter where you are supposed to be looking from, and the greater its volume, the greater its weight. Fire is always light, and the greater its volume, the greater its levity.' For a full commentary on the passage I may be allowed to refer to my own and Professor Stratton's notes, op. cit. 213–19.[1] It is clear that Theophrastus is only repeating the points of the Aristotelian criticism. This remains so, whatever view may be taken about the text of the clause over which Professor Stratton and I disagreed, or about our divergent interpretations of the reference to 'both of the statements' ascribed to Plato. I originally took—I do not feel so confident on the point now—the two statements to be the definitions of *κοῦφον* and *βαρύ* respectively; Professor Stratton takes them to be (*a*) the two definitions combined, (*b*) the statement, which he gets by correcting the text, that the more 'triangles' a body contains, the heavier it is. (But if Theophrastus ascribed *this* statement to Plato, as Aristotle seems to do, he was inaccurate, since Plato's whole point is that every body which is light in some region is heavy in some other, and vice versa. Hence you could not, on his theory, say unambiguously: 'what has more triangles is heavier'. You would need to add, 'in its own region'. Still, Professor Stratton may very conceivably be right, for neither Aristotle nor Theophrastus seems able to see at all clearly what the 'relativist' views of Timaeus about weight really mean. Yet, if Theophrastus made the much less cryptic criticism which Philippson restores to him, why was his text ever corrupted?)

63 e 8—64 a 1. λείου δ' αὖ . . . παρέχεται. The fourth pair of 'opposites' considered is 'rough and smooth', which may be very briefly dismissed. Roughness is hardness (*σκληρότης*) *plus* unevenness of surface (*ἀνωμαλότης*), i. e. an uneven hard surface feels rough; smoothness comes from evenness (*ὁμαλότης*) *plus* density (*πυκνότης*), i. e. an even surface which is close-grained or close in mesh feels smooth. With the clause *σκληρότης . . . μειχθεῖσα* we have to understand a *τὸ μέν* antithetic to the

[1] I have modified the wording of the remarks slightly to make it more accurate.

following τὸ δέ. For the selection of the first three ἐναντία considered by Timaeus as the fundamental 'opposites' in nature, cf. Aristot. *Physic.* Θ. 260^{b} 7 ἔτι δὲ πάντων τῶν παθημάτων ἀρχὴ πύκνωσις καὶ μάνωσις· καὶ γὰρ βαρὺ καὶ κοῦφον καὶ μαλακὸν καὶ σκληρὸν καὶ θερμὸν καὶ ψυχρὸν πυκνότητες δοκοῦσι καὶ ἀραιότητες εἶναί τινες. πύκνωσις δὲ καὶ μάνωσις σύγκρισις καὶ διάκρισις, καθ' ἃς γένεσις καὶ φθορὰ λέγεται τῶν οὐσιῶν.

64 a 2—65 b 3. μέγιστον δὲ . . . κατάδηλα. We now come to a matter which is of the first importance because of its intimate connexion with ethics, the psycho-physiology of pleasure and pain. Comparison with other dialogues, such as the *Phaedo*, *Gorgias*, and *Republic*, and above all *Philebus*, will show that the doctrine expounded is not merely part and parcel of Pythagoreanism, but is, in its main features, the view of Plato himself, and some of its ethical consequences are of the highest moment. On the strictly psycho-physiological side the discussion of pleasure and pain given here is the fullest and most illuminating to be found in Plato's dialogues. At the same time we shall see reason to hold that in its main lines the theory is so far from being a discovery of Plato that it goes back to Alcmaeon, the founder of Greek psychology; this explains how Socrates can be habitually represented as presupposing it without any full explanation.

First it may be desirable to comment on one or two matters of language.

64 a 2–6. μέγιστον δὲ . . . ἔχει. The theory is only offered as an account of the causes of pleasures and pains which accompany our perceptions of the 'opposites' just described (ἐν οἷς διεληλύθαμεν, i. e. perceptions of hot, cold, hard, soft, heavy, light, rough, smooth) and other sensations. There is no attempt to extend it to pleasures and pains attendant on non-sensuous activities. It is important to bear this in mind in judging of Aristotle's well-known criticism that the Platonic formulae about pleasure only hold good of 'bodily' pleasures. As Plato never uses them except of the σωματικαὶ ἡδοναί, we may presume that Aristotle is intending to criticize not so much Plato's own theory as an illegitimate extension of it. The antecedent to the ὅσα of a 4 would be an 'understood' ἐν ἅπασιν, 'the source of pleasures and pains in the cases we have examined and in all those which, involving sensations received through members of the body, involve also (καί) pleasures-and-pains in our members accompanying the sensations'.

64 a 6–b 2. ὧδ' οὖν . . . πρόσθεν. The expression τὸ τῆς εὐκινήτου τε καὶ δυσκινήτου φύσεως is the usual periphrasis for τήν τε εὐκίνητον καὶ δυσκίνητον φύσιν, 'the mobile and the immobile' (not, as A.-H. renders, 'the source of mobility and immobility'. The mistake leads him to mistranslate the ὅτι as though it were ἤ). Tr. simply 'reminding ourselves of the distinction already made between the mobile and the immobile'.

64 b 2. ταύτῃ. That is, the right method of discussion is always to begin by being clear about the division of our subject-matter into two well-constituted classes, one marked by the presence, the other by the absence, of an unmistakable and distinctive character, such as εὐκινησία in the case under discussion. The best comment on the remark is the instruction given by Socrates *Philebus* 16 c 10 δεῖν οὖν ἡμᾶς τούτων οὕτω διακεκοσμη-

μένων ἀεὶ μίαν ἰδέαν περὶ παντὸς ἑκάστοτε θεμένους ζητεῖν—εὑρήσειν γὰρ ἐνοῦσαν—ἐὰν οὖν μεταλάβωμεν, μετὰ μίαν δύο, εἴ πως εἰσί, σκοπεῖν, εἰ δὲ μὴ τρεῖς, ἤ τινα ἄλλον ἀριθμόν, καὶ τῶν ἓν ἑκείνων ἕκαστον πάλιν ὡσαύτως, μέχριπερ ἂν τὸ κατ' ἀρχὰς ἓν μὴ ὅτι ἓν καὶ πολλὰ καὶ ἄπειρά ἐστι μόνον ἴδῃ τις, ἀλλὰ καὶ ὁπόσα. The method (*διαίρεσις κατὰ γένη*) is usually spoken of as something peculiarly Academic, but in this very passage of the *Philebus* (16 c 5–10) it is said to have been bestowed on men by the gods *διά τινος Προμηθέως ἅμα φανοτάτῳ τινὶ πυρί*, and to have been received by the *παλαιοί, κρείττονες ἡμῶν καὶ ἐγγυτέρω θεῶν οἰκοῦντες*, an unmistakable allusion to Pythagoras and his followers, so that Plato means us to believe that in principle it goes back to the Pythagoreans. Hence he can make Timaeus refer to it as something familiar.

64 b 4. διαδίδωσι. A.-H. translates as if there were a comma after the word, understanding *πάθος* as the object to the verb. Then the words *μόρια ἕτερα . . . ἀπεργαζόμενα* would be an 'epexegesis' in apposition with the subject of the main sentence, and *μόρια* consequently grammatically nominative, 'the mobile . . . passes round the *πάθος*, one part producing the same identical effect on a second' (as has already been produced on the first). This is a possible view, and we have an exact parallel at 64 c 1 *infra οὐ διαδιδόντων μορίων μορίοις ἄλλων ἄλλοις τὸ πρῶτον πάθος*. But Timaeus seems rather to seek than to avoid variety of phrasing, and for that reason, I think it preferable to suppose that *μόρια* is the object-accusative to *διαδίδωσι*, so that the sense is 'when even a slight modification affects the naturally mobile, it (*τὸ κατὰ φύσιν εὐκίνητον*) sets up a circle of parts, each of them affecting the next in the same way (in which it has been affected itself)'.

64 b 6. τὴν δύναμιν = 'the quality' (in the wide Elizabethan sense), 'the character' of that which caused the disturbance. *δύναμις* in this sense is not infrequent in the Hippocratean corpus. Cf. *Περὶ ἀρχαίης ἰητρικῆς* 16 *ψυχρότητα δ' ἐγὼ καὶ θερμότητα πασέων ἥκιστα τῶν δυναμίων νομίζω δυναστεύειν ἐν τῷ σώματι*; *Περὶ φύσιος ἀνθρώπου* (Kühn) i. 354 *πῶς γὰρ ἂν ἐοικότα εἴη ταῦτα ἀλλήλοισιν; ὧν οὔτε τὰ χρώματα ὅμοια φαίνεται προσορώμενα, οὔτε τῇ χειρὶ ψαύοντι ὅμοια δοκέει εἶναι; οὔτε γὰρ θερμὰ ὁμοίως ἐστιν οὔτε ψυχρὰ οὔτε ξηρὰ οὔτε ὑγρά. ἀνάγκη τοίνυν ὅτι τοσοῦτον διήλλακται ἀλλήλων τὴν ἰδέην καὶ τὴν δύναμιν μὴ ἓν αὐτὰ εἶναι.* So below at c 6–7 *διὰ τὸ πυρὸς ἀέρος τε ἐν αὐτοῖς δύναμιν ἐνεῖναι μεγίστην* = 'because in them there is most of the quality of fire and air'.

64 c 7. τὸ δὴ τῆς ἡδονῆς καὶ λύπης. Not the direct object-accusative after the verb, since you could not say, e.g. *διανοεῖσθαι τὴν ἡδονήν*, 'to think of pleasure'. The accusative is adverbial and 'internal'; 'in the matter of pain and pleasure'.

64 d 5. τὰ περὶ τὴν ὄψιν αὐτὴν παθήματα. The *περί* c. accusative is the usual periphrasis for a genitive, and *ὄψις* means, again, the ray of light supposed to issue from the eye and to be the actual 'organ' of vision. Thus the phrase means 'what happens to the visual ray'.

64 d 7. συμφυές does not mean 'cognate' (A.-H.), but has its regular sense 'adhering to', 'grown into one with'. T. refers to his former statement that the ray issuing out through the eye is a member,

though a temporary member, of our body (cf. 45 c 4 *συμπαγὲς γενόμενον*). The similar word *σύμφυτον* in Plato, so far as I can see, always has the same meaning.

Now for the theory itself. It is this. A disturbance set up at the periphery of the body may be propagated inward until it reaches *τὸ φρόνιμον*, 'the seat of consciousness' (which will subsequently be identified with the brain). T.'s rather *naïf* assumption is that the disturbance is passed on in its original form to this centre. This happens when the first disturbance arises in a mobile part of the body, i. e. in a part composed largely of air and fire, as is the case with sensitive organs like the eye and the ear. The consequence is a sensation. But if the first disturbance happened to a part of the body which is mainly made of the less mobile 'roots' (such as a bone or a hair, which are largely composed of earth), no moderate disturbance is propagated inwards to *τὸ φρόνιμον*, and this is why hair and bone are insensitive. Further, disturbances have two directions or senses. They may tend to throw the part of the body affected into a condition which is *παρὰ φύσιν*, upsets its normal equilibrium, or they may tend to restore this normal equilibrium after previous disturbance. If the disturbance or the return from disturbance takes place very gradually and gently, this gives rise to no pain or pleasure, though it may originate a clearly apprehended sensation. Thus, whenever we see anything, the ray of light from the eye, which is actually a part of the body, is *cut* by the object seen. But the process is so gentle that, though it gives rise to very distinct colour-sensations, it causes no pain. We don't 'feel' the cut, though it is as real a cut as one inflicted on the flesh by a knife. But a rapid, sudden, and voluminous (*ἄθρόον*, d 1) disturbance of the normal equilibrium of the body is always painful, and a rapid, sudden, and voluminous restoration of the equilibrium after disturbance is always pleasurable. Thus a wound or burn is markedly painful because it is such a disturbance. As the wound or burn heals, there is a restoration of our *φύσις* or normal condition, but this is not felt as pleasurable, because it takes place slowly and gradually. Hence, though to recover from a bad burn is to return to *φύσις*, we do not feel any particular enjoyment as the burn heals. On the other hand, a disturbance of *φύσις* may be slow and gradual and so give rise to no pain, but the recovery from the disturbance may be sudden and violent. Then we get a pleasure not preceded by pain. An example is afforded by the intense pleasure yielded to some persons by sweet smells. T. means to suggest that in the absence of such smells there is some process of organic waste in the body, as there is when we go for a long time without food. But we do not feel any disagreeable hunger for perfumes because this process of depletion is so gentle and gradual. The sudden reversal when we are assailed by a massive or acute sensation of fragrance is, however, on the theory, as we find it to be in experience, markedly pleasant.

The main points are thus two. (1) The theory is only applied to pleasures and pains arising from the state of the bodily organism. There is no suggestion that it is meant to apply to pleasures and pains which have a mental source, such as the pleasures of learning or the pains of

remorse. We are carefully told at the outset that the pleasures and pains discussed are organic in origin (*περὶ ὅλον τὸ σῶμα*).

(2) The drift of the whole theory is exactly that of the discussions of pleasure in the *Philebus* and *Republic* ix. It is an attempt to apply in psychology the medical formula that our bodily life has an alternate rhythm of *κένωσις*, depletion, the falling of the quantity of some fundamental constituent in the body below the level required for health, and *ἀναπλήρωσις*, 'filling up' of the depletion. Thus hunger arises when there is not enough of the 'dry' in the frame to balance 'the moist', thirst when there is not enough of 'the moist' to balance 'the dry'. Eating when hungry, drinking when thirsty is taking in a stock of the 'dry' or 'moist', as the case may be, from without, and so re-establishing the proper balance. More serious and protracted disturbances of the balance are what we call diseases; thus dropsy is a permanent condition in which there is an overplus of the 'moist', a non-intermittent fever a condition in which there is a great overplus of the 'hot', and so on. The object of medical treatment is to restore the balance, and that is why diseases are cured by 'opposites'. Thus since the dropsical patient has too much of the 'moist' in him, you cure him by remedies which are 'dry', increasing the 'dry' in him at the expense of the too abundant 'moist'; you cure 'fever', for the same reason, by remedies which increase the 'cold' in the patient at the cost of the 'hot'. This is the view of disease which underlies the 'allopathic' doctrine in medicine; it amounts to the view that all medicines and all surgical operations are at bottom of the nature of 'purges'. The theory goes back in the end to the famous medical man Alcmaeon of Crotona, the founder of psychology and discoverer of the functions of the brain, who lived in the latter part of the sixth century (Aristot. *Met.* A. 986ª 29) and was intimate with the Pythagoreans. Alcmaeon's view was that 'health is kept up by the balance of powers (*ἰσονομίη*) in the body, the moist, the dry, the cold, the hot, the bitter, the sweet, and so on. The monarchy of any of these causes disease, because the monarchy of one destroys its opposite'. (Aetius *Placita* v. 30. 1, *Doxogr. Graec.* 442 = Alcmaeon Fr. 4, *Fr. d. Vors.*³ i. 136 'A. *τῆς μὲν ὑγιείας εἶναι συνεκτικὴν τὴν ἰσονομίαν τῶν δυνάμεων, ὑγροῦ, ξηροῦ, ψυχροῦ, θερμοῦ, πικροῦ, γλυκέος καὶ τῶν λοιπῶν, τὴν δ' ἐν αὐτοῖς μοναρχίαν νόσου ποιητικήν· φθοροποιὸν γὰρ ἑκατέρου μοναρχίαν.*) From Alcmaeon the theory passed to the Sicilian school of medicine through Pythagoreanism and Empedocles. It is commonly presupposed by both Plato and Aristotle, and is one of the sources of their common doctrine that *ἀρετή* (the health of the soul) depends on a 'right mean' or balance in our feelings and appetites. Alcmaeon, as we saw, was the ultimate source of the doctrine of the circles in the soul. Later on we shall find Timaeus adopting his discovery of the central place of the brain in the sensori-motor system. It should also be remembered that he was the first to dwell on the distinction between sensation and thought. (Theophrastus *de Sensu* 25, *Doxogr. Graec.* 506 = R.P. 66 c *ἄνθρωπον γάρ φησι τῶν ἄλλων διαφέρειν ὅτι μόνον ξυνίησι, τὰ δ' ἄλλα αἰσθάνεται μέν, οὐ ξυνίησι δέ.* Cf. the allusion of Socrates, *Phaedo* 96 b 4 *ἢ τούτων μὲν οὐδέν, ὁ δ' ἐγκέφαλός ἐστιν ὁ τὰς αἰσθήσεις παρέχων τοῦ ἀκούειν καὶ ὁρᾶν καὶ*

ὀσφραίνεσθαι, ἐκ τούτων δὲ γίγνοιτο μνήμη καὶ δόξα, ἐκ δὲ μνήμης καὶ δόξης λαβούσης τὸ ἠρεμεῖν, κατὰ ταῦτα γίγνεσθαι ἐπιστήμην;) It is historically right that there should be a large dose of Alcmaeon in the teaching of Timaeus. All that is known of him will be found collected and discussed in Beare's *Greek Theories of Elementary Cognition.* (The other chief medical school of the fifth century, that of Cos. to which Hippocrates, the most famous of all Greek physicians, belonged, was distinguished from the Sicilian precisely by the view that medicine should be based wholly on minute experimental knowledge of facts, not, like the system of Alcmaeon, on an *a priori* cosmological theory.)

The general result then is that so far as pleasure and pain due to the bodily condition of the organism are concerned, Plato always adopts the type of theory, still represented in modern times, which connects pain with disturbance of normal conditions, pleasure with return to them. Thus he would presumably have sympathized with the modern view which makes pain depend on waste, pleasure on repair of organic tissue. (For a discussion of the difficulties which beset the theory see Stout *Analytic Psychology*, Bk. II, c. 12. Stout's own theory, which is on more Aristotelian lines, is not, however, free from its own serious difficulties, nor, indeed, is any which has been yet advanced.)

We may now consider the connexion of the psycho-physical doctrine of κένωσις and ἀναπλήρωσις with the ethical theory about pleasure expounded most fully in the ninth book of the *Republic* and in the *Philebus*, though equally implied in the *Phaedo* and *Gorgias*. The general theory is already taken for granted in the *Gorgias*, a dialogue pretty certainly older than the *Republic*. Socrates there employs the ἀναπλήρωσις doctrine for the purpose of criticizing the view, championed by the otherwise unknown politician Callicles of Acharnae, that happiness consists in having violent passions and glutting them to the full. This, Socrates says, is the life not of a man but of a χαραδριός, a bird fabled to be so voracious that it evacuates as fast as it eats (*Gorgias* 494 b 6, and scholium *in loc.*; the lexicons identify the creature with the stone-curlew). It is also, Socrates says, what is meant by the story of those who are punished in the next life by having to draw water eternally in leaky pitchers. For this interpretation of the story, Socrates appeals to a κομψὸς ἀνήρ, ἴσως Σικελός τις ἢ Ἰταλικός (*Gorg.* 493 a 5, where, as the κομψὸς ἀνήρ and the Σικελός are mere echoes of the well-known drinking-song of Timocreon, Σικελὸς κομψὸς ἀνὴρ | ποτὶ τὰν ματέρ' ἔφα, the allusion is certainly to an Italian Pythagorean, presumably to Philolaus, who had been teaching Pythagoreanism in Thebes not many years before the end of the fifth century, *Phaedo* 61 d–e). The pitchers mean 'that part of the soul in which our ἐπιθυμίαι are' (*Gorg.* 493 b 1 τοῦτο τῆς ψυχῆς οὗ αἱ ἐπιθυμίαι εἰσί,—a plain ascription of the doctrine of the 'tripartite soul', to the Italian Pythagorean in question), and the fool's pitcher has a hole in it, 'because he is insatiable' (διὰ τὴν ἀπληστίαν). This, we observe, presupposes the idea of pleasure as a 'filling up', ἀναπλήρωσις. The life of cultivating violent ἐπιθυμίαι, and trying to get gigantic satisfactions for them, the ideal of the robuster type of Hedonist, is a 'fool's game' because the 'filling', as in the case of the χαραδριός, runs out as fast as it is put in. So the pitcher

never really gets full at all. Thus the *Gorgias* definitely represents the deplenishment-replenishment theory of pain and pleasure and also the doctrine of the three 'parts' of the soul as Pythagorean. Plato is certainly right on the first of these points, as we see from the connexion with what is known to have been the view of Alcmaeon about ἰσονομίη. Presumably, then, he is right on the second point too. This being so, the modern construction which represents the doctrine of the tripartite soul as invented by Plato as a justifiable reaction against the alleged 'intellectualism' of Socrates must be dismissed. We must recognize that the doctrine is a genuine piece of fifth-century Pythagoreanism, and that there is really no good reason why it should not go back to the famous apologue of the 'Three lives', attributed by ancient tradition to Pythagoras himself (Diogenes Laert. viii. 8). Hence we may be reasonably sure that Socrates really did make use of the idea for his own purposes, as Plato repeatedly makes him do, and we can understand, what on the current modern theories is perplexing enough, that Timaeus, who is assumed to have heard of the matter for the first time from the 'Platonic Socrates' twenty-four hours earlier, makes the doctrine the very foundation of his own psychology in the present dialogue. In the *Phaedo* we have at least one allusion in which the same psycho-physical doctrine is tacitly presupposed as familiar to Socrates' whole audience. When Socrates says (60 b 3–c 7) that it seems a paradox (ἄτοπον) that pleasure and pain are so connected that one treads on the heels of the other, as though they were two bodies with only one head (ὥσπερ ἐκ μιᾶς κορυφῆς ἡμμένω δύ' ὄντε), he is thinking of their connexion with the alternate rhythm of waste and repair, disturbance and restoration of the ἰσονομία in the body, though this does not need to be explained, precisely because his principal auditors, Cebes and Simmias, are themselves disciples of the Pythagorean Philolaus.

In *Republic* ix (583 b—587 e) the doctrine of κένωσις and ἀναπλήρωσις is employed for the purposes of the third and most searching of the arguments by which the life of the philosopher-king is shown to be, even on hedonistic grounds, preferable to any other. The contention is that physical cravings, and the ambitious man's craving for τιμή, distinction, are κενώσεις, states of *depletion*. Food and drink repair the 'depletion' of tissue in the body, and are 'fillings up' (585 a–b). Ignorance again is a κενότης, a state of emptiness, in the mind, and knowledge a 'filling up'. Inasmuch as truth is more real than food and drink, to be filled with knowledge and wisdom is more truly to be filled than to be filled with meat and drink,—it is a filling with 'living bread' and with water of which whoso drinks will not 'thirst again'. Again, because the soul itself is so much more real than the body (585 b–d), the filling of the soul is, for a second reason, a more real filling than that of the body. Since then, by the agreement of all parties to the argument, pleasure is being filled with 'what is naturally appropriate' (τὸ πληροῦσθαι τῶν φύσει προσηκόντων ἡδύ ἐστι, 585 d 11), the pleasures of knowledge and wisdom must be more truly and really pleasant than those of satisfying physical craving, μᾶλλον ὄντως τε καὶ ἀληθεστέρως χαίρειν ἂν ποιοῖ ἡδονῇ ἀληθεῖ, 585 e 1. It is here taken for granted that pleasure is 'being filled with the naturally

appropriate', but Socrates indicates the fact that the formula does not really quite fit the pleasures of 'mental' origin. He is careful not to call absence of knowledge and wisdom κενώσεις, depletions; he merely says that they are κενότητες, states of being unfilled. This is important, because on the theory it is the *process* of depletion which is painful, but we all know that mere absence of knowledge is not painful. (E. g. the ordinary man is utterly ignorant of the rules of the syllogism or the methods of the Infinitesimal Calculus, but he does not feel pained on that account.) Here, too, as in the *Timaeus*, the pleasures of smell give rise to the remark that there are even some 'bodily' pleasures which are 'pure' or 'unmixed', i. e. not dependent for their apparent intensity on any contrast with a simultaneous or preceding ἔνδεια, painful sense of want (584 b 5–6).

Even before we come to the argument about depletion and filling up, Socrates has made a distinction which also plays a great part in the *Philebus*, the distinction between the 'pure' (καθαραί) and the 'mixed' (μεικταί) pleasures. The most violently exciting of our so-called bodily pleasures are regularly preceded by a painful sense of want (ἔνδεια), and their intense pleasurableness, as it is held to be, depends on the piquant contrast. An example in the *Philebus* (45 b) is that there is usually no very great pleasure in drinking a glass of water, but if you are in a burning fever you may find the feeling-tone of the experience very intense indeed. Socrates therefore maintains that all pleasures which are dependent for our relish of them on contrast with painful tension, are 'mixed'—the experience is not *all* pleasure, it is pain and pleasure mingled. (Cf. Shelley's line about that 'unrest which men miscall delight'.) The excitement is intense and we fancy that the pleasure is intense too, but this is a mistake. When allowance has been made for the tension on which the experience depends for its exciting character, the 'balance' of pleasure in it may be quite trifling or even non-existent. (And this, no doubt, is why 'the gods approve | The depths, and not the tumults, of the soul', and why the supreme blessing invoked on us in our religion is the '*pax* Dei quae exsuperat omnem intellectum'.) The pure (καθαραί) or unmixed (ἀμιγεῖς) pleasures are those which do not depend on any contrast-effect for their full enjoyment. Those of smell are mentioned in the *Philebus*, as well as in the *Republic* and *Timaeus*, as an example of 'pure' pleasures of bodily origin. You do not need to have endured the distress of a 'stink' beforehand in order to get full enjoyment out of the fragrance of a rose, though to get the full pleasure out of eating you do need to have been first badly famished. ('Gravy soup! And I thought I didn't like gravy soup!') Hence there is an element of illusion about the 'mixed' pleasures which is absent from the 'pure'. In the case of the latter there is no painful tension to be allowed for, so that there is not the danger of supposing that an experience must be exceedingly pleasant because it is highly exciting. Hence Socrates calls these exciting experiences 'false' pleasures, because mankind in general make the error already spoken of in their estimate of them. It is only the calm 'unmixed' or 'pure' pleasures which are 'true', i. e. their hedonic magnitude really is what we take it to be.

This distinction of 'false' from 'true' pleasures was objected to by

Theophrastus (Fr. 85), and the objection has been repeated in modern times, notably by Grote (*Plato and the other Companions of Socrates* ed. 1885, iii. 382) and Gomperz (*Griechische Denker* ii. 468–9, iii. 364). The criticism takes the form of a complaint that the distinction of 'true' and 'false' cannot be applied to feelings, since any feeling whatever which is actually felt is an actual feeling. Plato never denies this. What he denies is that a pleasure is always as pleasurable as the man who feels it *thinks* it to be. There is nothing absurd in *this* denial. That Theophrastus should suppose that his argument had refuted Plato is in keeping with what seems to have been the superficial character of his mind; that after all these centuries modern Hedonists should repeat his *ignoratio elenchi* is only one of many proofs that none of them has really ever got inside his subject.

The *Philebus* is a much later dialogue than the *Republic*, possibly later even than the *Timaeus*,[1] but in any case belonging, as the style shows, to the same time of Plato's life as the *Laws*. It professes to be a conversation held by Socrates, some time after 427 B.C. (the visit of Gorgias to Athens in that year is referred to at 58 a 7, but presumably does not belong to a distant past since the speaker, who refers to what he had often 'heard' Gorgias say on that occasion, is still assumed to be quite a young man, and is actually called a παῖς, 16 b 4). Hence it is not surprising to find that it works all through with ideas which we can show to be Pythagorean, and that there is no development in it which *might* not have been made by the actual Socrates. The dialogue is specially concerned with the ethical problems about pleasure, and goes much more into psychological detail than any other of Plato's Σωκρατικοὶ λόγοι. It is rather in the penetrating insight into moral psychology than in any philosophical formula employed that we detect traces of the author of the dialogue behind the protagonist of his drama. The general position is that Socrates is discussing with two young men the question whether the 'good for man' is pleasure or is 'thought and intelligence'. This was, in fact, an issue in the Academy, though the allusion to both views in the *Republic* (vi. 506 b 2 ἀλλὰ σὺ δή, ὦ Σώκρατες, πότερον ἐπιστήμην τὸ ἀγαθὸν φῂς εἶναι ἢ ἡδονήν, ἢ ἄλλο τι παρὰ ταῦτα;) shows that the question might have been raised at an earlier time. We learn from Aristotle (*E. N.* vii. 1153^{b} 5) that there was a party in the Academy, led by Speusippus, who denied that pleasure is good at all. According to their doctrine pleasures and pains are both evil, and the wise man will avoid both. As they put it (ib. 1152^{b} 15) ὁ φρόνιμος τὸ ἄλυπον διώκει, οὐ τὸ ἡδύ. On the other hand, the eminent astronomer Eudoxus (*E. N.* x. 1172^{b} 9) actually identified the 'good' of which Plato spoke with ἡδονή on the ground that ἡδονή is the one and only thing all creatures pursue spontaneously (διὰ τὸ πάνθ' ὁρᾶν ἐφιέμενα αὐτῆς καὶ ἔλλογα καὶ ἄλογα,—thus the argument

[1] Fraccaroli finds a contradiction between *Tim.* 64 d 5 ff. and *Phileb.* 51 b, where the contemplation of regular geometrical forms and 'pure' colours is said to give rise to an 'unmixed' pleasure, and infers that the *Philebus* is the earlier dialogue. If the contradiction exists, the *Philebus*, however, might be correcting a too sweeping statement of the *Timaeus*. But is there any contradiction, when we remember that our dialogue deals only with the theory of pleasures of *bodily* origin?

is that ἡδονή is the one thing no creature needs to be artificially schooled or trained to pursue). Plato's dialogue appears to be written with an eye to this controversy, and, as we should expect, adopts a *via media*. It may be that the divinest life of all is one of thought pure and simple, but so long as we are concerned with a life for *man*, neither a life which is all agreeable feeling and no thought, nor one which is all thought and no pleasure is satisfactory. Plato maintains the best life for man, like all good things in this world, is a 'blend' (κρᾶσις) of the two elements, and the greater part of the dialogue is devoted to discussing the principle on which the blend should be made. Plato's object is to show that all branches of knowledge may be admitted, but that pleasures will only be allowed to find a place in the 'blend' *sous condition*. We may admit (*a*) those which are inseparable from the healthy discharge of function, and (*b*) of the others, those which are 'pure' or 'unmixed' and consequently 'true', 'undeceptive', those which do not presuppose any antecedent painful process of 'waste' or 'depletion'. This means principally the pleasures of science and art, but sweet smells are again mentioned to show that there are even some pleasures of sense which are 'unmixed'. For ths rest, the background of the dialogue is just the doctrine about depletion and repletion which had been given in the *Gorgias* as that of the κομψὸς ἀνήρ from Italy.

Plato's attitude towards pleasure and pain has been so often misconceived that it is worth while to call attention to the point that he has left us what may fairly be considered his last word on the matter in an important passage of the *Laws*, v. 732 d 8—734 e 2, where we have the advantage that he is speaking through the mouth of an aged Athenian who is anonymous and plainly has no function except to express the convictions of his creator. There is here, therefore, no question, as there reasonably is when Socrates or Timaeus is the speaker, of any possible accommodation of the language to doctrines held by these historical persons which may not have been altogether equally acceptable to Plato himself. There is no historical verisimilitude to be kept up, and Plato is therefore free to say just as much or as little as expresses his own personal feeling. In the passage in question the Athenian is imagining himself as a νομοθέτης addressing a body of citizens who are about to enter on corporate life under his institutions. His object is to explain to them the purpose of his legislative scheme as a whole and to win their sympathies for it. He has already explained that his whole social system is intended to foster a certain type of character depending upon a certain habitual estimate of the relative value of different goods. The general principle is that goods of the soul are immeasurably more valuable than any others, goods of body come next in the scale, and the 'external' goods of 'fortune' or 'estate' only last. The reasons for holding this to be at once the true and the morally worthy theory of life have already been eloquently presented. But there still remains another point of view to be considered. The auditors of the νομοθέτης are after all human and not divine (732 e 3 ἀνθρώποις γὰρ διαλεγόμεθα ἀλλ' οὐ θεοῖς). Hence, if we wish for their whole-hearted co-operation, we must satisfy them that the life of virtue is not only the worthiest but the most pleasant. We must dwell on its

'human' advantages (732 e 1 *λέλεκται σχεδὸν ὅσα θεῖά ἐστι, τὰ δὲ ἀνθρώπινα νῦν ἡμῖν οὐκ εἴρηται, δεῖ δέ*). Now men care very much about pleasure and pain, and the lawgiver must expect, therefore, that they will ask to be satisfied that there is a greater prospect of a 'balance of pleasure over pain' in the kind of life he recommends them to any other (733 a 1 *ὡς, ἄν τις ἐθέλῃ γενέσθαι καὶ μὴ νέος ὢν φυγὰς ἀπ' αὐτοῦ γένηται, κρατεῖ καὶ τούτῳ ὃ πάντες ζητοῦμεν, τῷ χαίρειν πλείω, ἐλάττω δὲ λυπεῖσθαι παρὰ τὸν βίον ἅπαντα*). Plato has none of the 'prejudice against pleasure' which has been incorrectly ascribed to him. He does not, like Kant, refuse to allow considerations of hedonic consequences to be taken into account at all, nor, like some of our anti-utilitarian moralists, urge that the 'balance of pleasure over pain on the whole account' is a thing at which it is unreasonable to aim. He has shown that he is no utilitarian by first constructing his theory of duty without any reference to the Hedonist's criterion of 'grateful feeling'. On the question of fact, what kind of life has the best prospects of realizing the 'balance' desired by the utilitarian, he is fully ready to argue that the calculation, properly worked, will come out in his own favour. The argument is as follows. It may be agreed that we all wish to have pleasure and not to have pain. As for the state of indifference, which is neutral in feeling-tone (the *ἄλυπον* of Speusippus), as in the *Philebus*, he refuses to admit that this is what satisfies us as men. We prefer it to pain, but prefer pleasure to it (733 a 9 *ἡδονὴν βουλόμεθα ἡμῖν εἶναι, λύπην δὲ οὔθ' αἱρούμεθα οὔτε βουλόμεθα, τὸ δὲ μηδέτερον ἀντὶ μὲν ἡδονῆς οὐ βουλόμεθα, λύπης δὲ ἀλλάττεσθαι βουλόμεθα*). Similarly we prefer 'less pain with more pleasure' but not more pain with less pleasure'; between 'equal' balances we are unable to decide (733 b 5 *ἴσα δὲ ἀντὶ ἴσων ἑκάτερα τούτων οὐχ ὡς βουλόμεθα ἔχοιμεν ἂν διασαφεῖν*). Now pleasures and pains may differ *πλήθει*, in number, *μεγέθει* in volume, and *σφοδρότησιν ἰσότησίν τε*, in intensity. So that the case stands thus (735 c). We prefer a life in which both kinds of feelings are many and great and intense, but pleasure is in excess; we reject a life in which, with the same conditions, pain is in excess. Again, if both are few and small and of low intensity (*ἠρεμαῖα*), we prefer the life in which the balance is in favour of pleasure and reject that in which it is on the side of pain. Where the balance is even (*ἐν ᾧ δ' αὖ βίῳ ἰσορροπεῖ*, 733 c 6), we prefer such a life to one in which pain exceeds but not to one in which pleasure exceeds. The Athenian then goes on to argue that there are four types of life which we have already recognized as good, the temperate (*σώφρων*), the prudent (*φρόνιμος*), the valiant (*ἀνδρεῖος*), and the 'wholesome' (*ὑγιεινός*, 733 e 3–5). Opposed to them are respectively the lives of the fool, the coward, the profligate, and the 'morbid'. If we pit the *σώφρων βίος* against the *ἀκόλαστος βίος*, a 'competent judge' (*ὁ γιγνώσκων*) will recognize that the pains, pleasures, desires, passions (*ἔρωτες*) of the former are 'mild' (*ἠρεμαίας, μαλακάς*, 734 a 1), those of the other intense (*σφοδράς, συντόνους, οἰστρώδεις*, 734 a 3–4), but the former leaves a balance in favour of pleasure, the latter on the side of pain in respect of frequency, volume, and intensity (*μεγέθει καὶ πλήθει καὶ πυκνότησιν*, 734 a 7). So that even on a hedonic calculation, if it is properly worked, the *σώφρων βίος* is preferable, and we

see that it is true that no one is ἀκόλαστος of set choice, but from miscalculation or want of self-command, or both (ὡς . . . πᾶς ἐξ ἀνάγκης ἄκων ἐστὶν ἀκόλαστος· ἢ γὰρ δι' ἀμαθίαν ἢ δι' ἀκράτειαν ἢ δι' ἀμφότερα, 734 b 3–5), the same conclusion which we shall find Timaeus urging on rather different grounds. And the same result will follow if we compare any one of the four types of the virtuous life with its opposite. We thus reach the same conclusions about the ethical significance of pleasure and pain with which we are already familiar, and the line of reasoning adopted assumes the theory of health and disease which we have traced back to Alcmaeon, but there is an entire absence of the κένωσις-ἀναπλήρωσις psycho-physical *formula*. It looks as though when Plato is speaking purely on his own account he does not feel it natural to give the Pythagorean medical language the same prominence which he feels it ought to have in the utterances of Timaeus and Socrates.

Aristotle deals with the subject of pleasure, with special reference to the controversy between the Hedonists and their opponents, twice in the Nicomachean *Ethics*. The first of these two passages (*E. N.* vii. 1152 b 1—1154 b 34) is directed against the position of the downright anti-Hedonists who held that both pleasure and pain are bad, and its object is to show that *their* arguments are not even sufficient to prove that pleasure may not be the *summum bonum*. It used at one time to be fashionable to regard the party attacked in this polemic as Antisthenes and the imaginary 'Cynic' school. This, however, is quite out of the question. For (1) as Wilamowitz has said, the Cynics were never a 'school' at all. There were only individual eccentrics who were known as κυνικοί, and it is reasonably certain that Antisthenes was not one of them; the original κύων was Diogenes; though Aristotle refers to the Ἀντισθένειοι as an example of incompetence in logic, he never refers in any way to κυνικοί, and apparently no more knew of 'Cynic' philosophers than he did of 'Cyrenaics'. We may be quite sure that the anti-Hedonists, whose views he thinks it worth while to examine at length, were not 'originals' of the type of Diogenes and Crates, more remarkable for freaks of indecorum than for theory of any kind. And there is no evidence whatever that either Antisthenes or Diogenes and his apes professed to regard pleasure as bad. Of Antisthenes it is expressly recorded that he regarded the pleasures of exertion as positively good (Stobaeus *Florileg.* 29. 65 = R. P. 280 ἡδονὰς τὰς μετὰ τοὺς πόνους διωκτέον, ἀλλ' οὐχὶ τὰς πρὸ τῶν πόνων). (2) Aristotle mentions one name and only one in connexion with the arguments he is discussing, that of Speusippus (*E. N.* vii. 1153^{b} 5 ὡς γὰρ Σπεύσιππος ἔλυεν οὐ συμβαίνει ἡ λύσις). (3) Nearly all the arguments rehearsed, as Bt. has pointed out in his commentary on the *Ethics*, are taken from Platonic dialogues, the peculiarity of the treatment being that arguments used in the dialogues with reference to particular classes of pleasures are taken from their context and used in an indictment against pleasures generally. Thus Aristotle enumerates the four following theses: (*a*) no pleasure is good at all (*E. N.* vii. 1152^{b} 8 τοῖς μὲν οὖν δοκεῖ οὐδεμία ἡδονὴ εἶναι ἀγαθόν); this is a view ascribed at *Philebus* 44 c–d to certain persons of whom Socrates speaks as δεινοὶ περὶ φύσιν, 'eminent in natural science', and

treats as the exaggeration of lofty-minded souls. The description does not in the least fit Antisthenes or the *κύνες*, who regarded science as worthless (Diog. Laert. vi. 103 = R. P. 239 *ἀρέσκει οὖν αὐτοῖς τὸν λογικὸν καὶ τὸν φυσικὸν τόπον περιαιρεῖν . . . μόνῳ δὲ προσέχειν τῷ ἠθικῷ . . . Γράμματα γοῦν μὴ μανθάνειν ἔφασκεν ὁ Ἀντισθένης τοὺς σώφρονας γενομένους, ἵνα μὴ διαστρέφοιντο τοῖς ἀλλοτρίοις*), and whose notorious contempt for ordinary decency would of itself have kept Plato from speaking of them as persons with a *φύσις οὐκ ἀγεννής*, but it exactly fits Speusippus who wrote voluminously on biology and was also an authority on the Pythagorean numbers. (*β*) Pleasure is *the* good. This thesis is expressly attributed in the tenth book to Eudoxus. (*γ*) Some pleasures are good, though most are not (1152^b 10 *ἔνιαι μὲν εἶναι* (sc. *ἀγαθαί*), *αἱ δὲ πολλαὶ φαῦλαι*); this is, in fact, the view both of Plato and of Aristotle himself. (*δ*) Even if all pleasures are good, the *summum bonum* is not pleasure (1152^b 11 *εἰ καὶ πᾶσαι ἀγαθόν, ὅμως μὴ ἐνδέχεσθαι εἶναι τὸ ἄριστον ἡδονήν*). The denial that the *ἄριστον* is *ἡδονή* is again the view of both Plato and Aristotle. Thus we are clearly dealing throughout with a disagreement in the Academy itself.

Aristotle next goes on to rehearse the arguments of those who maintain the extreme view that no pleasure is good, for the purpose of showing that these arguments do not even prove that pleasure may not be the *ἄριστον*. The arguments specified are as follows:

(*a*) All pleasures are *γενέσεις*, and no *γένεσις* is as good as the end in which it culminates (1152^b 13 *πᾶσα ἡδονὴ γένεσίς ἐστιν εἰς φύσιν αἰσθητή, οὐδεμία δὲ γένεσις συγγενὴς τοῖς τέλεσιν*). This is from *Philebus* 53 c ff., quoted above, and is the reason given there by Socrates for denying that pleasure is *the* good.

(*b*) The 'temperate' man, who has mastery over himself avoids pleasures (*ὁ σώφρων φεύγει τὰς ἡδονάς*), and the 'wise' or 'prudent' man aims not at pleasure but at freedom from pain (*ὁ φρόνιμος τὸ ἄλυπον διώκει, οὐ τὸ ἡδύ*). Plato never says either of these things, but the former statement might be regarded by an anti-Hedonist as implied in the stress laid both in the *Republic* and the *Laws* on the necessity of discipline in refusing to give way to the solicitations of unseemly, unworthy, and inopportune pleasures. The other remark would seem to come from Speusippus, as it is to him that Aristotle ascribes the theory that pain and pleasure are both bad.

(*c*) Pleasures, especially the exciting ones, hinder thought (1152^b 16 *ἐμπόδιον τῷ φρονεῖν αἱ ἡδοναί, καὶ ὅσῳ μᾶλλον χαίρει, μᾶλλον*). This comes from *Phaedo* 64 d 2 *φαίνεταί σοι φιλοσόφου ἀνδρὸς εἶναι ἐσπουδακέναι περὶ τὰς ἡδονὰς καλουμένας τὰς τοιάσδε, οἷον σιτίων [τε] καὶ ποτῶν*; and the following page, where, however, it is not pleasure but the presence of the body which is said to interfere with thinking (65 a 9 *πότερον ἐμπόδιον τὸ σῶμα ἢ οὔ*;). Nothing is said in the dialogue about any but the 'bodily' pleasures.

(*d*) There is no 'science' of pleasures, but every good is the product of some 'science' (1152^b 18 *τέχνη οὐδεμία ἡδονῆς· καίτοι πᾶν ἀγαθὸν τέχνης ἔργον*). This is a misapplication of the argument of the *Gorgias* where Socrates denies that *ῥητορική* is a science and maintains that it is

only a τριβή, a professional 'knack', on the ground that the aim of the ῥήτωρ is merely to please the taste of an ignorant audience, and that skill in doing this depends not on scientific grasp of any principles but on mere practice (ἐμπειρία, *Gorgias* 463 a–c). What Socrates says about the pretensions of Gorgias to teach a τέχνη is illegitimately made into an argument to prove that pleasure is a bad thing, a thesis which Socrates never advances.

(*e*) Even infants and irrational animals pursue pleasure ⟨and therefore pleasure cannot be the highest aim of a reasonable man⟩ (1152ᵇ 19 ἔτι παιδία καὶ θηρία διώκει τὰς ἡδονάς). This, again, seems to be a Platonic reminiscence. The παιδία, perhaps, came from the passage in the *Gorgias* where Socrates says that a confectioner would always be safe in denouncing a physician if the case were to be heard by a jury of children (*Gorgias* 464 d 5). The θηρία may perhaps most probably be taken from *Philebus* 67 a 14 ff. οὐκοῦν πέμπτον κατὰ τὴν κρίσιν, ἣν νῦν ὁ λόγος ἀπεφήνατο, γίγνοιτ' ἂν ἡ τῆς ἡδονῆς δύναμις.—ἔοικεν.—πρῶτον δέ γε οὐδ' ἂν οἱ πάντες βόες τε καὶ ἵπποι καὶ τἆλλα σύμπαντα θηρία φῶσι τῷ τὸ χαίρειν διώκειν. Aristotle then adds, as arguments to prove the milder positions that not all pleasures are good and that τὸ ἄριστον is not pleasure, the considerations that some pleasures are disgraceful (αἰσχραί) and some pleasant things unwholesome (νοσώδη), and, once more, that pleasure is οὐ τέλος ἀλλὰ γένεσις (1152ᵇ 23). Here, again, we are dealing with the matter of the *Gorgias* and *Philebus*.

Aristotle himself expressly agrees with Plato that much which is commonly called pleasant is not really so, and that many things which ordinary men find pleasant are bad. It is his own doctrine that it is only the man of good 'character' to whom what is 'by nature' pleasant regularly appears pleasant. As he puts it himself (*E. N.* x. 1176ᵃ 15), δοκεῖ δ' ἐν ἅπασι τοῖς τοιούτοις εἶναι τὸ φαινόμενον τῷ σπουδαίῳ. The standard is the way in which a 'good specimen of the type' is affected, εἰ δὲ τοῦτο καλῶς λέγεται, καθάπερ δοκεῖ, καὶ ἔστιν ἑκάστου μέτρον ἡ ἀρετὴ καὶ ἀγαθός, ᾗ τοιοῦτος, καὶ ἡδοναὶ εἶεν ἂν αἱ τούτῳ φαινόμεναι καὶ ἡδέα οἷς οὗτος χαίρει. The most important point which emerges from the whole of the discussion in *Ethics* vii is the proposal to emend the definition of ἡδονή as a γένεσις εἰς φύσιν αἰσθητή by saying ἐνέργεια for γένεσις and ἀνεμπόδιστος for αἰσθητή (1153ᵃ 14). The effect of the modifications is (*a*) that the definition is no longer based specially on consideration of the 'bodily' pleasures, and (*b*) that consequently the reference to 'repair' as the basis of pleasure disappears. Aristotle himself is thus on the side of the theory (championed e. g. by Stout) which connects pleasure as a normal accompaniment with 'unthwarted conation'. This fits in well with the case of the 'higher' pleasures, but does not work well in the very class of cases upon which the 'waste-and-repair' theories are based. How e. g. does the 'unthwarted activity' theory explain why the taste of sugar is so pleasant to persons whose palates have not been artificially 'spoiled'? It may be questioned whether psychologists have yet developed any single theory which does justice to 'all the appearances'. The conditions on which feeling-tone depends are probably more complicated than any of the current types of 'algedonic' theory is willing to admit.

In the tenth book of the *Ethics* Aristotle is looking at the matter from the other side. He now starts with the Hedonists who identified pleasure with the good, and it is from him we learn that Eudoxus was the leader of the party, and that it was he who put forward the argument, mentioned in that dialogue and adopted afterwards by Epicurus, that it is proved to be the good by the fact that all sentient creatures pursue it as if by instinct (and a *universal* instinct cannot be supposed to be a delusion). Aristotle points out the inconclusiveness of Eudoxus' arguments, but says that his Hedonism made a great impression because of the sanctity of his personal character (*E. N.* x. 1172^{b} 15 *ἐπιστεύοντο δ' οἱ λόγοι διὰ τὴν τοῦ ἤθους ἀρετὴν μᾶλλον ἢ δι' αὐτούς· διαφερόντως γὰρ ἐδόκει σώφρων εἶναι*). If *he* said that pleasure is the good, it was felt that this was no apology for personal weaknesses.

The section of *Ethics* x which discusses this view runs from 1172^{a} 19 to 1176^{a} 29, and the main object is to show that the Hedonist arguments are as unsatisfactory as the anti-Hedonistic. Aristotle thus gets the chance to develop his own view that pleasure accompanies and 'completes' (*τελειοῖ*) all unimpeded exercise of activity (*ἐνέργεια*), and consequently the worthier the activity, the worthier is the accompanying pleasure. (And since *some* activities are admittedly downright bad, it follows that pleasures arising from them are bad too.) But the main point is that the pleasure is only an accompaniment or by-product; it is not the activity itself. Hence it is the exercise of the noblest activity possible to men, not the pleasure which accompanies the exercise, which is the 'good for man'. This is fully in accord with Plato's own estimate in the *Philebus*, where even the 'unmixed' pleasures occupy only the fifth place in the enumeration of the constituents of the good (*Philebus* 66 c 4 *πέμπτας τοίνυν, ἃς ἡδονὰς ἔθεμεν ἀλύπους ὁρισάμενοι, καθαρὰς ἐπονομάσαντες τῆς ψυχῆς αὐτῆς, ἐπιστήμαις, τὰς δὲ αἰσθήσεσιν ἑπομένας*). It is not against Plato but against Eudoxus that Aristotle is arguing. In fact, on the *ethical* issue about pleasure he represents the orthodox Platonist view, opposed alike to the anti-Hedonism of Speusippus and the Hedonism of Eudoxus. A.-H. is quite mistaken in finding a direct attack on Plato in anything said about pleasure in the *Ethics*. Aristotle would be the more keenly interested in the controversy that Speusippus was, like himself, one of the members of the school specially devoted to biology, and Eudoxus the author of the doctrine of the spheres on which his own cosmology is based. (How deeply he was interested is best shown by the constant recurrence of points urged in this controversy as examples of dialectical reasoning throughout the *Topics*.) Aristotle begins by calling attention to the great practical importance of pleasure and pain for the formation of character and the consequent use made of them by all who have to mould the character of the young (*E. N.* x. 1172^{a} 20 *μάλιστα γὰρ δοκεῖ συνῳκειῶσθαι τῷ γένει ἡμῶν, διὸ παιδεύουσι τοὺς νέους οἰακίζοντες ἡδονῇ καὶ λύπῃ*). Here he is simply epitomizing what is said with great emphasis in many places in the *Laws*, especially perhaps B. 653 a 5 *λέγω τοίνυν τῶν παίδων παιδικὴν εἶναι πρώτην αἴσθησιν ἡδονὴν καὶ λύπην, καὶ ἐν οἷς ἀρετὴ ψυχῇ καὶ κακία παραγίγνεται πρῶτον, ταῦτ' εἶναι, φρόνησιν δὲ καὶ ἀληθεῖς δόξας βεβαίους εὐτυχὲς ὅτῳ καὶ πρὸς τὸ γῆρας παρεγένετο κτλ.*, the sentence which seems

to be in his mind in an earlier place where he emphatically commends Plato for saying that *ὀρθὴ παιδεία* means learning from our earliest days to feel pleasure and pain rightly (*E. N.* ii. 1104^{b} 11–13). He wishes, in fact, to suggest that the anti-Hedonists can hardly be convinced of the truth of their own doctrine (exactly as Socrates suggests the same thing at *Philebus* 44 c 5 ff.). They probably try to persuade their followers that all pleasure is a bad thing because they know what a seductive influence the hope of pleasure is in actual life, and they wish rather to steel men against the seductions of forbidden pleasure than to teach them sound psycho-physics (*E. N.* 1172^{a} 29 *οἳ μὲν ἴσως πεπεισμένοι οὕτω καὶ ἔχειν, οἳ δὲ οἰόμενοι βέλτιον εἶναι πρὸς τὸν βίον ἡμῶν ἀποφαίνειν τὴν ἡδονὴν τῶν φαύλων, καὶ εἰ μή ἐστίν*). I think this a direct allusion to the remark of the *Philebus* just referred to that anti-Hedonism is a pardonable exaggeration due to the contempt felt by high-minded men for the more ignoble pleasures. Aristotle urges that pious fraud of this kind is dangerous. Men judge the anti-Hedonist by his practice, and if they find him untrue to his own teaching, they pay no more attention to his theories (ib. 1172^{a} 34 *οἱ γὰρ περὶ τῶν ἐν τοῖς πάθεσι καὶ ταῖς πράξεσι λόγοι ἧττόν εἰσι πιστοὶ τῶν ἔργων . . . ὁ γὰρ ψέγων τὴν ἡδονήν, ὀφθείς ποτ' ἐφιέμενος, ἀποκλίνειν δοκεῖ πρὸς αὐτὴν ὡς τοιαύτην οὖσαν ἅπασαν· τὸ διορίζειν γὰρ οὐκ ἔστι τῶν πολλῶν*). This may be a severe reflection on the discrepancy between the theory and the practice of Speusippus himself, since we read of him (Diog. Laert. iv. 1 that *ὀργίλος καὶ ἡδονῶν ἥττων ἦν*). The argument of Eudoxus, Aristotle goes on to say, was that all creatures whatever spontaneously seek pleasure and avoid pain. But what all creatures spontaneously seek clearly must be what Plato meant by *the* good (1172 b 12 *τὸ δὴ πάντ' ἐπὶ ταὐτὸ φέρεσθαι μηνύειν ὡς πᾶσι τοῦτο ἄριστον ὂν . . . τὸ δὲ πᾶσιν ἀγαθὸν καὶ οὗ πάντ' ἐφίεται, τἀγαθὸν εἶναι*). This is the very argument for Hedonism advanced at *Philebus* 11 b 4 *Φίληβος μὲν τοίνυν ἀγαθὸν εἶναί φησι τὸ χαίρειν πᾶσι ζῴοις καὶ τὴν ἡδονὴν καὶ τέρψιν, καὶ ὅσα τοῦ γένους ἐστὶ τούτου σύμφωνα*), and the coincidence is one of the proofs that Plato, too, has Eudoxus chiefly in mind in that dialogue. Again, pleasure is the one thing about which we think it absurd to ask any further reason *why* it is sought. It is self-evidently intrinsically good (1172 b 20 *μάλιστα δ' εἶναι αἱρετὸν ὃ μὴ δι' ἕτερον μηδ' ἑτέρου χάριν αἱρούμεθα· τοιοῦτο δ' ὁμολογουμένως εἶναι τὴν ἡδονήν· οὐδένα γὰρ ἐπερωτᾶν τίνος ἕνεκα ἥδεται, ὡς καθ' αὑτὴν οὖσαν αἱρετὴν τὴν ἡδονήν*). Again, pleasure, it is said, by its addition makes every other so-called 'good' more desirable; but that which thus augments all 'good', must itself be the good (1172 b 25 *αὔξεσθαι δὲ τὸ ἀγαθὸν αὐτῷ*). Aristotle points out that this very argument had already been used in the *Philebus* (60 d) to prove that pleasure is *not* the good, since every one would prefer pleasure *plus* thought and memory to pleasure without them, and this shows that the 'mixed' life is better than pleasure. On the other hand, Plato's contention in the *Philebus* that pleasure and pain both belong to the class of the *ἄπειρον*, the 'more or less', does not prove that some definite pleasure (which would, of course, belong to the 'third class' of 'combinations' of *ἄπειρον* and *πέρας*), may not be the very highest good (1173 a 15–28). C. W., who attacks A.-H. for omitting this point in his

summary, apparently thinks Aristotle's argument a telling one against Plato. But it is not really directed against Plato at all. In the passage to which Aristotle is referring (*Philebus* 27 e), *Philebus*, who is arguing the case for Hedonism, maintains that the very reason why pleasure is so infinitely good is that it is 'unlimited in degree'. Socrates replies that surely this must, in the Hedonist view, also be the reason why pain is so very evil. So even if pleasure is the good, the fact that it belongs to the class of ἄπειρον cannot be the sufficient justification for calling it the good. The Hedonist must find a better argument than that. Plato does not suggest, nor does Aristotle accuse him of suggesting, that Socrates' argument has disproved the possibility that some definite pleasure may not be the good. It takes forty more pages of close reasoning before we reach *that* conclusion. The natural inference is that Aristotle is criticizing not the *Philebus* but the use made of it by Academic anti-Hedonists, who, as we saw, were trying to press all sorts of Platonic texts into the service of their polemic. This is all the more likely that Aristotle connects this argument very closely with another to the effect that pleasure cannot be the good because it is not a 'quality' (*E. N.* x. 1173ᵃ 13 οὐ μὴν οὐδ' εἰ μὴ τῶν ποιοτήτων ἐστὶν ἡ ἡδονή, διὰ τοῦτ' οὐδὲ τῶν ἀγαθῶν· οὐδὲ γὰρ αἱ τῆς ἀρετῆς ἐνέργειαι ποιότητές εἰσιν, οὐδ' ἡ εὐδαιμονία). He is thus examining an argument to this effect: the good is a ποιότης, pleasure—because it is an ἄπειρον is not a ποιότης, *ergo*, pleasure is not the good. Now Plato never says that the good is a ποιότης nor that pleasure is not one. He only uses the word—which appears to come from the technical language of medicine—once, and then in a context which has nothing to do with ethics, *Theaetetus* 182 a 8, apologizing for it as an ἀλλόκοτον ὄνομα. Thus we are plainly dealing with a polemic constructed by certain Academics, not Plato, out of a passage of the *Philebus*. If we bear in mind that ἕξεις 'fixed conditions' are one kind of ποιότητες (*Categ.* 8 b 26 ἓν μὲν οὖν εἶδος ποιότητος ἕξις καὶ διάθεσις λεγέσθωσαν), and that the anti-Hedonist Speusippus defined the good as ἕξις τελεία ἐν τοῖς κατὰ φύσιν ἔχουσι (Speusippus Fr. 57), there does not seem to be much doubt who is really responsible for the reasoning Aristotle is criticizing.

The next anti-Hedonist argument examined is that 'the good is something complete or finished (τέλειον), but pleasures are always incomplete, for they are motions or processes' (κινήσεις καὶ γενέσεις, *E. N.* x. 1173ᵃ 29 τέλειόν τε τἀγαθὸν τιθέντες, τὰς δὲ κινήσεις καὶ τὰς γενέσεις ἀτελεῖς, τὴν ἡδονὴν κίνησιν καὶ γένεσιν ἀποφαίνειν πειρῶνται). Here, again, we are dealing with the use of the *Philebus*. That the good, whatever it may turn out to be, must be something 'complete' is laid down as axiomatic at *Philebus* 20 d 1 (τὴν τἀγαθοῦ μοῖραν πότερον ἀνάγκη τέλεον ἢ μὴ τέλεον εἶναι;—πάντων δήπου τελεώτατον, ὦ Σώκρατες). Aristotle himself adopts this statement at *E. N.* 1. 1097ᵃ 27, δῆλον ὡς οὐκ ἔστι πάντα τέλεια· τὸ δ' ἄριστον τέλειόν τι φαίνεται. And we saw that Plato accepts from the anti-Hedonists (*Philebus* 53 c), the very persons whom Aristotle is criticizing, the argument that all pleasures are γενέσεις and therefore are 'for the sake of' something else which results from the γενέσεις, and are dependent on that something else for their worth. So that in criticizing *this* position Aristotle is by implication criticizing Plato, though we may

reasonably hold that he is still directly concerned with Speusippus and his definition of the good for man as an ἕξις τελεία, exactly as he is in the first book of the *Ethics*, when he makes so much of the contention that εὐδαιμονία is not a ἕξις but an ἐνέργεια. The point on which Plato himself incurs the criticism which Aristotle proceeds to pass is that he regards feeling pleasure as a κίνησις or γένεσις, whereas, as Aristotle holds, it is something very different. It accompanies an ἐνέργεια or activity. He means, in effect, that the exercise of a natural function need not be a process towards the development or production of anything; it may be the *use* of an already developed organ, as seeing or hearing is. If we got eyes by repeatedly seeing, you might regard sight as a γένεσις εἰς οὐσίαν, the eye being the οὐσία in which it issues. But in fact we begin by having eyes and go on to use them. Hence the pleasures attendant on sight are concomitant with an ἐνέργεια, not with a γένεσις. This is a legitimate criticism of the psycho-physics of the *Philebus*. The point is that the exercise of our functional activities need not have an external end. It may have no end beyond itself, and therefore the argument that no pleasure can be the highest good, because, as is alleged, pleasures are γενέσεις, processes of development to an external end, is not valid, since it rests on a false premise. I do not see how A.-H. supposes himself to have met it by saying that Plato's theory of pleasure is not psychological but purely physical. I cannot understand how this can be seriously held by any one who has read the *Republic* or *Philebus*. And if it were true, as a physical fact, that pleasure only arises while the organism is returning to equilibrium after disturbance, seeing the face of the world ought not to be pleasant, since every *fresh* stimulation of the eye is a disturbance of organic equilibrium. It would be much better to be content with pointing out that Plato at least tries to meet the difficulty in the *Timaeus* by the doctrine that in the case of the 'pure' pleasures of sense the disturbance has been insensible. There is no ethical disagreement connected with the difference in psycho-physics, since Aristotle is as decided as Plato on the points that many pleasures are not good at all, and that no pleasure whatever is *the* good.

Aristotle next turns to the depletion-repletion formula itself, which he regards as an attempt to make the doctrine that pleasures are γενέσεις more precise by specifying the kind of γένεσις in question (1173^{b} 7 καὶ λέγουσι δὲ τὴν μὲν λύπην ἔνδειαν τοῦ κατὰ φύσιν εἶναι, τὴν δ' ἡδονὴν ἀναπλήρωσιν). He urges that these depletions and repletions are bodily, and that the theory arises from an improper extension of the analogy of the pleasures which accompany the satisfaction of hunger and thirst. If pleasure is being filled up to the normal condition, the pleasure should be felt by that in which the filling up takes place, in fact by the body. But manifestly this is not so (οὐ δοκεῖ δέ; i.e. every one knows that it is the ψυχή which feels pleasure). Pleasure, then, is not the process of being filled up, though, no doubt, one may feel pleasure while the filling up is taking place, as one may feel pain when one is being cut (1173^{b} 12 γιγνομένης μὲν ἀναπληρώσεως ἥδοιτ' ἄν τις καὶ τεμνόμενος λυποῖτο. The τεμνόμενος, which is wrongly obelized by Bywater and 'emended' variously by various Germans, is an allusion to the illustrations from τομαί and

καύσεις in the present section of the *Timaeus* 64 d 7, 65 b 2). So, he adds, the formula will not apply to the pleasures which Plato had recognized as ἄλυποι, the 'pure' ἡδοναί of learning (αἱ μαθηματικαί) and such pleasures of sense as those due to smell and much that we see and hear, or to the pleasures of memory and anticipation. 'Of what are these the γενέσεις? there has been no deficiency of anything of which a filling up might occur' (1173^{b} 19). Here, again, Aristotle cannot be directly controverting Plato. The examples of pleasures not preceded by ἔνδεια are actually borrowed from the *Philebus*, where all those Aristotle enumerates are mentioned, and Plato never says that the depletion-repletion formula applies to purely mental pleasures. Even Timaeus is expressly talking only about pleasures and pains of bodily origin (64 a 2 μέγιστον δὲ καὶ λοιπὸν τῶν κοινῶν περὶ ὅλον τὸ σῶμα παθημάτων κτλ.). Presumably Speusippus and his friends extended the formula to cover *all* pleasures and pains. But it is true that Plato's use of the formula might suggest that all pleasures ought to be explicable by it, and it seems fair that Aristotle should lay stress on the point that it fails just for the very kinds of pleasure which Plato thought most worth having.

64 d 7–e 4. ταύτῃ γὰρ . . . συγκρίσει. The visual ray being made of the finest kind of fire, has particularly mobile and small particles. Hence, on the principles just laid down, any disturbance set up by stimuli is very readily transmitted over its whole length, and so it has a very fine sensibility; but it offers very trifling resistance to disturbance of its motions, and easily comes together again after disturbance. To 'cut' it is like slashing at the air. Hence the cutting, colliding, &c., involved in vision is attended with no pain, and the reuniting of the ὄψις with no pleasure.

64 e 4—65 a 1. On the other hand, bodies composed of larger particles only yield to a considerable force on the part of the agent (τῷ δρῶντι), and so disturbance and restoration of the normal condition in them are attended by pain and pleasure. Note the recurrence of the non-Attic δρῶντι for ποιοῦντι. The word δρᾶν in this sense is perhaps a medical technicality. Cf. the use of ὁ δρῶν for 'the practitioner', Hippocrates Κατ' ἰητρεῖον 2 τὰ δὲ ἐς χειρουργίην κατ' ἰητρεῖον, ὁ ἀσθενέων (the patient), ὁ δρῶν (the operator), οἱ ὑπηρέται (his subordinates), τὰ ὄργανα (his instruments) κτλ.; ib. 3 ὁ δρῶν ἢ καθήμενος ἢ ἑστεώς κτλ.; *infra* οὕτως γὰρ ἂν ὁ μὲν δρῶν ὁρῴη, τὸ δὲ χειριζόμενον οὐχ ὁρῷτο. ὁ δρῶν in the sense of 'the operator' would readily give rise to τὸ δρῶν in the more general sense of 'the agent'. Ultimately, perhaps, the use goes back to the old ritual meaning of δρᾶν, which also yields us the noun τὸ δρᾶμα. Surgeon and actor alike, in the beginning, are 'celebrants' in a ritual. Since Timaeus is a medical man as well as an astronomer and geometer, we may expect to find traces of his medical studies in his vocabulary. Perhaps it is for the same reason that phrases like ὁ εὖ δρῶν for ὁ εὖ ποιῶν are, as Bonitz's *Index* will show, fairly common in Aristotle.

64 e 6. ἴσχει. Not quite 'cause' (A.-H.) but 'get', i.e. 'feel', 'are affected by'. Timaeus conforms in language to the popular usage by which pains and agreeable sensations are located in different members,

as though these members themselves were the subjects experiencing them.

65 a 1–b 3. ὅσα δὲ . . . κατάδηλα. An explanation (*a*) of the occurrence of 'bodily' pleasures not preceded by a painful sense of want or depletion, and (*b*) 'bodily' pains recovery from which is not felt as pleasant. In the first case the *κένωσις*, in the second the *ἀποπλήρωσις* or *κατάστασις* (restoration of normal function), is too gentle and gradual to be perceived. Timaeus is thus making use of the same principle of continuity to which Leibniz appeals for his doctrine of *petites perceptions*, and many modern psychologists for their theories about the 'subconscious' or 'subliminal' self.

65 a 2. τὰς ἀποχωρήσεις, 'evacuations' a technical sense of the word. Aristot. *de Generatione Animal.* A. 726ª 20 *κατὰ τὴν τῆς ξηρᾶς ὑποστάσεως ἀποχώρησιν*, 'by the passage at which the residual matter of solid food is evacuated', ib. 726ᵇ 12 *ἡ τοῦ καθαροῦ καὶ ὑγιεινοῦ αἵματος ἀποχώρησις*. So for the verb, Aristot. *de Generatione Animal.* A. 725ᵇ 15 *διὸ ἐνίων γε καὶ ἄγονόν ποτε γίνεται τὸ ἀποχωροῦν*. (Xenophon *Cyrop.* i. 6. 36, quoted by L. and S., can hardly be depended on; the reading they assume there, *ἀνάγκη ἀμφοτέρους . . . ἐπὶ τὰ ἀναγκαῖα σχεδὸν ἅμα πάντας ἀποχωρεῖν δεῖσθαι*, is uncertain). In the present passage *ἀποχωρήσεις* and *κενώσεις* are virtually synonyms.

65 a 5. τῷ θνητῷ τῆς ψυχῆς. As we have heard nothing yet of the 'mortal part' of the soul, and shall not reach the account of it until p. 69, we must suppose that Timaeus assumes that the general outlines of the doctrine he is afterwards going to expound are already familiar to his audience and accepted by them, i. e. that they accept as current doctrine the theory of the 'tripartite' soul and of the *λογιστικόν* as the only element in it which is divine and consequently immortal. Unless this is supposed to be common ground, his present allusion to the 'mortality' of a certain part of the soul would be unintelligible to his hearers. This strongly confirms the assertion which Posidonius seems to have made, no doubt in his commentary on the *Timaeus*, that the whole doctrine of the 'tripartite' soul was pre-Socratic and Pythagorean. (See Bt. on *Phaedo* 68 c 2, for Galen's repeated statement that the doctrine is that of Pythagoras. Plato certainly does not mean to represent it as a Socratic novelty, since he makes Timaeus teach it at length, and also presupposes it both in the passage of the *Phaedo* and in the exegesis of the tale about the 'cracked pitcher' ascribed to the Italian *κομψός* in the *Gorgias*.) It may be said that the company have already heard about the 'tripartite' soul from Socrates when he related his conversation with Glaucon and Adimantus to them. But Socrates has nowhere *said* in the *Republic* that the *θυμοειδές* and *ἐπιθυμητικόν* are 'mortal'. At best he has hinted this ambiguously at *Rep.* 611 b 9—612 a 6.

65 a 6. περὶ τὰς εὐωδίας. A.-H. reminds us that *Philebus* 51 b, speaking of the pleasures we derive from beautiful colours, patterns (*σχήματα*), and smells, says in the same fashion, not that they are preceded by no *ἔνδεια* but that they are preceded by no *conscious* *ἔνδεια* (*καὶ ὅσα τὰς ἐνδείας ἀναισθήτους ἔχοντα καὶ ἀλύπους τὰς πληρώσεις αἰσθητὰς καὶ ἡδείας [καθαρὰς λύπῶν] παραδίδωσιν*). He also rightly refers to Aristot. *de Sensu*

445ª 16 for a Pythagorean view that some creatures are nourished by smell. Since this would mean that ὀσμαί are to these creatures τροφή which has to be taken into the body, and presumably gives rise to waste products which have to be excreted again, the belief presupposes the application of the κένωσις-ἀναπλήρωσις formula to ὀσμαί.

65 b 2. περὶ τὰς καύσεις καὶ τομάς. That is, if the painfulness of a burn or a wound is due to the disturbance of the normal state of the body, why, on our theory of pleasure-pain, is not recovery, which is return to the normal state, positively pleasurable? Why is not the healing of the burn attended with local sensations which are highly agreeable? The reply is that as the process is slow and gradual, the accompanying ἡδοναί are 'below the threshold'.

65 b 4—66 c 7. καὶ τὰ μὲν δὴ . . . γλυκύ. Timaeus now goes back to take up the subject which had been postponed at 61 d 4. He said there that he would for the time being 'postulate' our possession of sense-organs, and would talk of the properties of body they enable us to perceive, postponing the account of the structure and working of the organs themselves. He now turns to this part of the subject, and gives us an account of the way in which bodies act upon each of our special sense-organs, the ἴδια παθήματα, 'special affections' of the various organs, beginning with that of taste. This is followed by a similar treatment of the 'special affections' of the nostrils, the ear, the eye. Those of the skin (and cartilages and tendons) have, in fact, already been dealt with in the account of the four chief pairs of 'opposites', 61 d 5—64 a 1. Tastes, then, are produced by the contraction or dilatation of the passages of the organ of taste, the tongue, and depend directly on the roughness or smoothness of particles of bodies taken into the mouth. This is the general theory. As we go on to the details we shall see that Timaeus is following in the track of Alcmaeon, of whose views Theophrastus reports (*de Sensu* 25, *Doxogr. Graec.* 506) that we 'discern tastes by the tongue; being warm and soft it melts things by its warmth, and it is its rarity of texture and softness which enable it to receive and transmit (their savours)' (γλώττῃ δὲ τοὺς χυμοὺς κρίνειν· χλιαρὰν γὰρ οὖσαν καὶ μαλακὴν τήκειν τῇ θερμότητι· δέχεσθαι δὲ καὶ διαδιδόναι διὰ τὴν μανότητα καὶ ἀπαλότητα. Cf. Aetius *Placita* iv. 18. 1, *Doxogr. Graec.* 407 Α. τῷ ὑγρῷ καὶ τῷ χλιαρῷ τῷ ἐν τῇ γλώττῃ πρὸς τῇ μαλακότητι διακρίνεσθαι τοὺς χυμούς). Diogenes of Apollonia worked the same doctrine into his eclectic revival of old theories in the Periclean age. (Aetius *Placita* iv. 18. 2, *Doxogr. Graec.* 407 Δ. τῇ ἀραιότητι τῆς γλώττης καὶ τῇ μαλακότητι κτλ.) We need not suppose Timaeus to be influenced by Diogenes; it is Alcmaeon, no doubt, whom he is following. In the account of taste Diogenes merely repeated Alcmaeon (Theophrastus *de Sensu* 40, *Doxogr. Graec.* 510 τὴν δὲ γεῦσιν τῇ γλώττῃ διὰ τὸ μανὸν καὶ ἁπαλόν). And we must be careful to remember that none of the speculations about sense-physiology on which we are now entering were originated by Plato. He *may* have made up some of the minor details himself, but in all the main outlines it is demonstrable that the basis of what Timaeus says is first the sense-physiology of Alcmaeon, who, as Aristotle has informed us, lived in the old age of Pythagoras, and next the doctrines of Empedocles. Alcmaeon and

Empedocles are just the two authorities whom a scientific man of Locri, interested as T. shows himself to be in medicine, would naturally follow.

65 b 6–7. τά τε πάθη . . . δρώντων. The αἰτίαι mean the causes of the πάθη, or 'affections' of our sensibility; the δρῶντα are the 'operators' in the process, i. e. the bodies which stimulate the sense-organs, and the genitive δρώντων is one of 'origin', 'the causes which lie in, belong to, the agents'.

65 c 6–d 4. ὅσα μὲν γὰρ . . . φαίνεται. The theory then is that in the tongue there are tiny 'veins', φλέβια. This seems really to mean 'nerves', the existence of which Alcmaeon, who called them πόροι, 'passages', connecting the sense-organs with the brain, was apparently the first to discover. (*EGPh.*[2] 194 n. 3. It has sometimes been doubted whether Alcmaeon's πόροι were really nerves or not, and a layman has no right to a decided opinion on such a question. But I find it very hard not to believe that what Chalcidius is describing in the section of his commentary where he speaks of Alcmaeon and his dissections (§ 246, Wrobel pp. 279–80) is the actual course of the optic nerve as it may be laid bare by dissection. He seems to say that Alcmaeon really did discover this, and I do not think there can be much doubt that the ultimate source of his statements about matters of this kind is Posidonius, and Posidonius can be shown to have drawn freely on the stores of Academic and other earlier learning. These φλέβια are, so to say, the 'test-tubes', δοκίμια (the word properly means reagents used to test the purity of metals, cf. *Ep. Jacobi* i. 3 τὸ δοκίμιον ὑμῶν τῆς πίστεως κατεργάζεται ὑπομονήν), of the tongue. Substances containing earthy particles dry up the moisture of the φλέβια and contract them. If the contraction is considerable, the corresponding taste or flavour is called στρυφνόν, 'astringent'; if the contraction is less violent, the taste is αὐστηρόν. As the lexicons will show, the word was specially used of certain wines, as opposed to γλυκύς, and Plato, in the same way, uses it metaphorically of the 'stiff' and 'crabbed' temper of old age as contrasted with the lightness of youth (*Laws* B. 666 b 5, where the social use of wine is said to have been bestowed on men by Dionysius ἐπίκουρον τῆς τοῦ γήρως αὐστηρότητος . . . ὥστε ἀνηβᾶν ἡμᾶς, καὶ δυσθυμίας λήθη γίγνεσθαι μαλακώτερον ἐκ σκληροτέρου τὸ τῆς ψυχῆς ἦθος, καθάπερ εἰς πῦρ σίδηρον ἐντεθέντα γιγνόμενον, καὶ οὕτως εὐπλαστότερον εἶναι). Hence 'dry', in the sense in which we contrast a 'dry' with a 'sweet' wine is perhaps the nearest equivalent.

65 d 1. τεταμένα ἐπὶ τὴν καρδίαν. This should be noted in view of Timaeus's subsequent strong adherence to the doctrine of Alcmaeon about the central character of the brain. It is at least admitted that the 'heart' is an immediate centre for the φλέβια by means of which taste is effected. We may suppose that there is a further connexion of some kind between this centre in the heart and the brain.

65 d 4–e 1. τὰ δὲ τούτων . . . ὠνόμασται. First as to the grammar, τούτων means the φλέβια of which we have just heard, and the genitive is not, as A.-H. assumes, partitive, but a so-called 'objective' genitive depending on ῥυπτικά, 'substances which rinse these φλέβια'. That this is the meaning is sufficiently shown by the next clause, 'and all deter-

gents of the tongue'. Theophrastus understood the words in this obvious sense, as is shown by his paraphrase (*de Sensu* 84, *Doxogr. Graec.* 525 τὸ ῥυπτικὸν τῶν πόρων). The taste of such a detergent is called πικρόν, 'bitter', when the process is so violent that it involves an actual dissolution of the 'substance' of the passages. (The substance is thus thought of as affecting the sense-organ exactly as it does e.g. a piece of metal dissolved in a powerful 'acid'.)

65 d 7. αὐτῆς τῆς φύσεως. A particularly good example of φύσις for a 'body' or 'substance' in the chemist's sense of that word. The phrase is exceedingly relevant to the dispute on the point whether φύσις in the earliest cosmologists means 'primary *body*', and seems to me to give a great deal of support to Bt.'s view that this is what the word originally meant in science. Since soda (λίτρον) is the one example given, Plato's πικρόν would seem to answer most nearly to what we call the 'alkaline' taste.

65 e 1–4. τὰ δὲ ὑποδεέστερα . . . φαντάζεται. Less violently detergent substances with a kindred taste we call ἁλυκά, 'saline', and find their savour agreeable.

65 e 4—66 a 2. τὰ δὲ τῇ τοῦ στόματος . . . ἐλέχθη. Particles which readily absorb the heat of the mouth and, as Timaeus holds, actually increase its temperature, and are so light that they rise and pervade the sense-organs (αἰσθήσεις, 65 e 7) in the head—(he is thinking of substances which, taken into the mouth affect the nostrils also, like mustard)—and 'cut' whatever meets them, are called δριμέα, 'pungent'. The general theory is thus that all tastes are due to the special character of earthy particles suspended in the substance tasted. Empedocles is said by Theophrastus (*de Sensu* 9, *Doxogr. Graec.* 502) to have had no special theory about tastes, but merely to have accounted for them, as he did for other sensations, by the intrusion of particles into the 'passages' of the sense-organs (περὶ δὲ γεύσεως καὶ ἁφῆς οὐ διορίζεται καθ' ἑκατέραν οὔτε πῶς οὔτε δι' ἃ γίγνονται, πλὴν τὸ κοινὸν ὅτι τῷ ἐναρμόττειν τοῖς πόροις αἴσθησίς ἐστιν). We may assume that in whatever he did say on the subject he followed the line of Alcmaeon, the original discoverer of these passages, much as Timaeus seems to be doing. There is an inconsistency here which shows that T.'s doctrine is not after all a perfectly successful blend of mathematics and biology. It has been assumed all along that things get their flavours from the 'earthy' particles they contain (γήινα μέρη, 65 d 2). And earth is for mathematical reasons denied to be convertible into anything else. Yet we are now told that the particles which give the pungent its peculiar taste *are* converted into fire by the action of the heat of the mouth, which is itself supposed to be due to the presence of fire in the organism (συνεκπυρούμενα καὶ πάλιν αὐτὰ ἀντικάοντα τὸ διαθερμῆναν). This ought really to be no more possible on the principles of T.'s physics than it is in actual fact. Yet that he seriously means to be understood so seems clear from the τέμνοντά τε πάνθ' ὁπόσοις ἂν προσπίπτῃ, since τὸ τέμνειν is specially characteristic of the tetrahedra of fire. This is not the only example we shall find of physiological processes which ought not to be possible if the physics of the dialogue are sound.

65 e 7. πρὸς τὰς τῆς κεφαλῆς αἰσθήσεις. The use of αἴσθησις for 'organ of sense' is too common to need any elaborate illustration. See

Bonitz *Index Aristotelicus* s. v. So *Phaedo* 75 e 3 *ταῖς αἰσθήσεσι χρώμενοι περὶ αὐτὰ ἐκείνας ἀναλαμβάνομεν τὰς ἐπιστήμας* means 'by using our organs of sense', and at *Laws* xii. 942 e 4 the head is spoken of as *ἔχον τὰς κυρίας ἁπάσας αἰσθήσεις*, 'containing the most important organs of sense'. The technical term *αἰσθητήριον* was perhaps too much of a technicality in Plato's time to be used in literary prose; the lexicon gives only one reference to Hippocrates for it before the time of Aristotle. The mouth is in the head too, but its supposed special connexion by the *φλέβια* with the heart explains the opposition of it to the eyes, ears, and nostrils. The effect of pungent things like onions and mustard on the eyes will explain the use of the plural *αἰσθήσεις*, but it is, no doubt, the effect on the nostrils which is chiefly intended.

66 a 2–b 7. *τὸ δὲ αὖ . . . προσρηθῆναι.* We come next to the 'sharp' tastes (*ὀξύ*) of the 'acids'. The general meaning is clear, but the words are almost unconstruable, and there is probably some primitive corruption too deep for certain correction, since all our MSS. agree substantially in the same text, and there appear to be no variants provided by early testimonies. Corruption is therefore not likely to have extended beyond a few letters, and this consideration should rule out any 'emendation' which involves far-reaching alteration. In the MSS. the first three words of the sentence are *τῶν δὲ αὐτῶν*, and they are retained by most of the editors (Bekker, St., Martin, Hermann, the Zürich editors, A.-H.). Yet the sense obtained seems impossible, as it would make the *ὀξέα* now to be described a mere sub-class of the *δριμέα*, 'and when these same (particles) have been previously refined', &c. But the description when it follows is inconsistent with this, since it gives the most prominent part in the production of *τὸ ὀξύ* to the presence of *air*, which has not come into the account of any of the already described substances. Hence Schneider's correction *τὸ δὲ αὖ τῶν*, adopted by Bt.,[1] seems to me necessary as a minimum change. The supposed error is one of the most natural; the reading of ΑΥΤΩΝ as one word would almost inevitably produce it. If we accept this initial slight alteration, we see that the general structure of the sentence is of a kind very common in the *Laws*. The subject of the principal enunciation is *τὸ τῶν προλελεπτυσμένων*, itself a periphrasis of the common kind for *τὰ προλελεπτυσμένα*, 'on the other hand, (*αὖ*) those which have been refined already by decomposition. . . .' The sentence is then interrupted by the insertion of the long relative clause *ἃ δὴ νοτίδος . . . λεχθῆναι*, and so, when the main statement is resumed, the subject has to be repeated and, as usual, a *δέ* is inserted. This, however, leaves the worst difficulties still unaccounted for. On what does *μέρεσιν* in 66 a 4 depend? How are we to account for the *ἔχοντα* in a 5, and for the infinitives in the relative clause, *γενέσθαι, περιστῆναι, λεχθῆναι*, where we expect finite verbs? I do not venture to do more than indicate my own views on these intricate points with a great deal of diffidence, referring for fuller discussion to the notes of Stallbaum, Martin, A.-H., and the long discussion in C. W., pp. 28–37. As to the first point it seems to me clear that *μέρεσι* must be taken with *συμμετρίαν ἔχοντα*, with the sense 'are duly proportioned to the particles of earth'.

[1] And Rivaud.

This involves separating ὅσα ἀέρος from ἔχοντα, and understanding the whole clause to mean ἔχοντα συμμετρίαν τοῖς γεώδεσι μέρεσιν καὶ ⟨τοῖς μέρεσιν⟩ ὅσα ἀέρος ⟨ἐστί⟩, 'duly proportioned to the particles of earth and to those of air'. This was St.'s view of the construction of the clause as it stands, though he also held that the whole passage has suffered too deeply from corruption for restoration. It follows that ἔχοντα and the words dependent on it are co-ordinate with προλελεπτυσμένων and ἐνδυομένων, the meaning being, 'Those particles which have been previously refined by decomposition and are making their way into the narrow "veins", and are duly proportioned to the particles of earth and air contained there'. Thus it looks as if we ought to remove grammatical difficulty by reading ἐχόντων for ἔχοντα, the corruption being explained by a conscious or unconscious false assumption that the participle belongs to ὅσα ἀέρος. This change appears to have been suggested by Lindau, and is only not adopted by St. because he holds that corruption has gone too far for any certain restoration of the true text. Yet I think it quite possible to defend ἔχοντα as it stands. Since τὸ τῶν προλελεπτυσμένων (we *must* have that change at least) is equivalent in meaning to τὰ προλελεπτυσμένα, I do not think it impossible that the author of the *Laws* and *Philebus* might not let himself pass at ἔχοντα to a neuter plural nominative by a *constructio ad sensum*, though I do not feel sure that a parallel to so violent a change can be actually produced.[1]

Finally, as to the infinitives in the relative sentence. If the text is sound, we might perhaps suppose that the force of the ποιεῖν before κυκᾶσθαι is irregularly carried on into the relative clause, so that it is to be construed as though there were a finite verb ποιεῖ in it upon which the infinitives depended. An alternative would be to attempt an explanation on the analogy of the construction common in Plato by which the relative, as well as the principal, clause in *oratio obliqua* is allowed to take the accus.-infinit. construction. I do not see why this usage might not have been extended to a case like the present, so that the effect of the ὥστε before ποιεῖν in a 5 should be felt throughout the relative clause, though the case is not one of *oratio obliqua*, but I can find no exact parallel, and the grammars seem to fight shy of this difficult sentence. In any case προσρηθῆναι in the principal sentence after its resumption is the main verb, and we can only account for its mood by supposing an illogical influence of the preceding infinitives. The meaning fortunately is clear. 'But substances which have been already refined by decomposition and

[1] Yet cf. *Laws* A. 643 d 8 ff., if the MSS. are right in this violently discussed passage, as I believe they are; λέγομεν ὡς τὸν μὲν πεπαιδευμένον ἡμῶν ὄντα τινά, τὸν δὲ ἀπαίδευτον ἐνίοτε εἴς τε καπηλείας καὶ ναυκληρίας, καὶ ἄλλων τοιούτων μάλα πεπαιδευμένων σφόδρα ἀνθρώπων. After long consideration I cannot help believing that the text here is sound, and that the meaning demanded by the context is 'we speak of one man as educated and another as uneducated, it may be, for the work of a retail dealer or a skipper, and ⟨we speak⟩ of other such men as mighty well educated'—i. e. we talk of 'education' for other commercial pursuits besides the two specified (though, the speaker is explaining, no 'education' of this commercial kind is the 'education' on which he is insisting as the most important business of the πόλις). The transition from λέγομεν ὡς c. accus. absol. to λέγομεν ὡς with genitive absol. here seems very harsh, but all the attempts to get rid of it seem to involve either a wild licence of conjecture or an unsuitable sense, or both.

then make their way into the narrow little veins, and have a due proportion with the earthy particles and those of air in the composition of these veins, such that they agitate them (viz., the earthy and airy particles of the φλέβια), and make them jostle and so change their positions (περιπίπτειν), taking up new ones and leaving others empty as they globe themselves round the intruding particles—they thus form round hollow drops of water (ὕδατα), vessels of moisture earthy or pure as the case may be, containing air by the formation of a hollow moisture round the air, and those made of pure water surround the air transparently and are called bubbles, but those made of earthy water which effervesces as it rises are spoken of by the names of seething and fermentation—the cause of these effects, I say, is called acid.'[1] Thus the idea is that acids poured on anything cause bubbling, effervescence or fermentation, as the case may be. This means that they cause a hollow sphere of water to be formed round a centre which holds air or earth. If the acid itself contains no earth, and perhaps we should understand, though this is not expressed, if what is contained in it is pure air, you get a transparent bubble. If there is earth in the bubble—and possibly he means also, if there is earth as well as air at its centre—it is frothy and turbid, and you get the appearance of frothing and fermenting. As acids all have a sharp taste, T. assumes that they act in this way, forming bubbles, on the organs of taste themselves.

66 b 2. νοτερὰ ἀγγεῖα ἀέρος. The words seem curiously superfluous after the preceding νοτίδος περὶ ἀέρα κοίλης περιταθείσης. May it be that they are an echo from some poetical description of a child blowing bubbles?

66 b 7-c 7. σύμπασιν δὲ . . . γλυκύ. Sweet tastes are produced in a way which is, in a sense, the opposite of all those we have described. When the particles which get into the passages of the tongue are 'suitable to the structure' of that organ, so that they smooth away any abnormal roughnesses and contract or dilate, as the case may be, the already unduly dilated or contracted passages, this is a cure for 'enforced' or 'constrained' conditions of the organ of taste, and the substances which produce this effect are what we call 'sweets'; in accord with the general theory about bodily pleasures already laid down, all such tastes are peculiarly 'pleasant and grateful'.

66 b 7-c 1. σύμπασιν . . . ἐναντίον. That is, you cannot classify tastes in sets of two of which one is the 'opposite' of the other, or at least you cannot do this completely. The general theory was that 'to one thing one is opposite', ἓν ἑνὶ ἐναντίον. But τὸ γλυκύ is in a way ἐναντίον not to *one* special taste (as τὸ λευκόν is to τὸ μέλαν, or τὸ κοῦφον to τὸ βαρύ), but to all the six tastes, στρυφνά, αὐστηρά, πικρά, ἁλυκά, δριμέα, ὀξέα hitherto discussed. T. means a hint against possible abuses of the doctrine ἓν ἑνὶ ἐναντίον. The ἐναντιότης is, of course, that all the other tastes are connected with some more or less unnatural disturbance of the normal state of the tongue and its connexions, sweet tastes with the restoration of the normal condition. This is meant to explain why all persons with palates not artificially spoiled like 'sweets'; it is implied that they find the

[1] This is, in effect, also the rendering of Rivaud.

other flavours disagreeable, and that the liking for them has to be acquired.

66 c 1. προφάσεως, virtually = *αἰτίας*, 'cause'. This sense of the word is not unfrequent in Plato. Cf. *Rep.* viii. 556 e 6 *πόλις ἀπὸ σμικρᾶς προφάσεως . . . νοσεῖ τε καὶ αὐτὴ αὐτῇ μάχεται*, *Tim.* 76 e 4 *τούτῳ δὴ τῷ λόγῳ καὶ ταῖς προφάσεσι ταύταις* (for this cause) *δέρμα τρίχας ὄνυχάς τε ἐπ' ἀκροῖς τοῖς κώλοις ἔφυσαν.*

66 c 2. σύστασις ἐν ὑγροῖς. For it is only in the process of being 'dissolved' or 'melted' in the mouth that a thing is sapid at all.

One may compare Aristotle's account of tastes. He discusses them briefly at *de Anima* B. 422ª 8–ᵇ 16. His view is that it is only what is actually or potentially moist (*ὑγρόν* cf. *σύστασις ἐν ὑγροῖς*) that has a taste. Hence he lays great stress on the point that, if we are to discern tastes properly, the tongue must neither be actually moist nor yet incapable of being moistened. It must be dry until it is moistened by the substance which is tasted. (This looks like a covert criticism of the part Timaeus makes the natural moisture of the mouth itself play in his account of the *πικρά* and the *ὀξέα*.) It is a plain fact, Aristotle holds, that we are unable to taste when the tongue is either unnaturally dry or unusually moist. (For example the reason why sick folks find the taste of everything bitter is that, owing to their diseased state, their mouths are already filled with a bitter moisture.) As for taste-qualities, Aristotle tries to arrange them, as he does colours, in a linear series with a pair of 'opposites', *γλυκύ* and *πικρόν*, as its end-terms. (He thus disregards Timaeus' correct warning that there is no one 'opposite' to *τὸ γλυκύ*.) The intermediate term next to *τὸ γλυκύ* is the 'unctuous' or 'oily' (*λιπαρόν*), that next to *πικρόν* is the 'saline' (*ἁλμυρόν*). Between these are the pungent (*δριμύ*), dry (*αὐστηρόν*), and acid (*ὀξύ*). Tastes are also discussed in the little essay *de Sensu et Sensibilibus* 442ª 12—442ᵇ 26. Here, as before, Aristotle tries to make a linear series of tastes with *γλυκύ* and *πικρόν* as the end-terms, but he now regards *λιπαρόν* as much the same as *γλυκύ*, and *ἁλμυρόν* as the same as *πικρόν* (*μόνος μὲν οὖν λιπαρὸς ὁ τοῦ γλυκέος ἐστὶ χυμός, τὸ δ' ἁλμυρὸν καὶ πικρὸν σχεδὸν τὸ αὐτό*, 442ª 17), so he gets the series *γλυκύ*, *αὐστηρόν*, *δριμύ*, *στρυφνόν* (astringent), *ὀξύ*, *πικρόν*. He then tries to make a fanciful correspondence of tastes with colours, equating sweet with white, oily with *ξανθόν* (tawny yellow?), *πικρόν* with black, and the rest with the reds, greens, and blues. The rest of the discussion is taken up by a polemic against Democritus and *οἱ πλεῖστοι τῶν φυσιολόγων* who, Ar. says, 'most paradoxically' reduce taste to touch (*ἀτοπώτατόν τι ποιοῦσι· πάντα γὰρ τὰ αἰσθητὰ ἁπτὰ ποιοῦσι*, 442ª 30). Much of this polemic would be applicable to Timaeus, e.g. the argument that since variations in shape are infinitely numerous, Democritus ought to have held that the number of different tastes is infinite. The attempt to arrange tastes in a linear series is particularly unfortunate, as modern psychologists recognize.

66 d 1—67 a 6. καὶ τὰ μὲν . . . ἀποδιδόν. *Smells.* There are no *εἴδη* of smell. Timaeus means, for one thing, what modern psychologists mean when they say that smells do not lend themselves to classification on any scientific principle; you cannot 'order' them. There are an indefinite plurality of them and you cannot reduce them, as you can colours,

tastes, &c., to a few well-defined types and the forms intermediate between these types. But this is only a consequence of something more ultimate, and it is this more ultimate fact which is T.'s primary meaning. He is giving a physical and physiological explanation of the impossibility of such a classification. He means that there is no one εἶδος, regular geometrical structure, among those assigned to the particles of the 'roots', which produces smell. The particles of all the four types are absolutely odourless. The φλέβια (he means really the threads of the olfactory nerves, which he, like Alcmaeon, holds to be hollow 'passages'), are too broad to be stimulated by particles of fire or air, which slip through them without contact, too narrow to admit particles of water or earth. Consequently no body which is in the form of any of the 'roots' has any smell. This implies that particles can only be odorous when they are in the transitional process of being transformed either from water to air or from air to water. It is just then, when they are neither icosahedra nor octahedra but passing from one shape to the other by a series of intermediaries which are not 'regular' polyhedra that they neither slip through the φλέβια without contact nor are too big to get into them at all. The reason for the assertion is the empirical observation that smells are only given off by things which are being 'wetted or decomposed or melted or volatilized' (66 d 7–8). Now when air becomes water it passes through the stage ὁμίχλη, 'mist', when water turns to air it goes through the stage of καπνός, 'smoke' or 'vapour'. (These correspond to the two forms of vapour, ὑγρά and ξηρὰ ἀναθυμίασις, which play so prominent a part in Aristotle's meteorology.) Hence it is only things which are in the intermediate stage of ὁμίχλη or καπνός which have a smell. We can see this if we close the nostrils (e.g. by placing a thick cloth before them), and then take a deep breath; we smell nothing, as the obstacle lets through the air but keeps out the ὁμίχλη or καπνός, since its structure is less fine. Smells, then, cannot be properly classified. We can only distinguish them as pleasant and unpleasant, and neither the pleasant nor the unpleasant have received a distinctive name; all alike are merely called ὀσμαί.

66 d 2. εἴδη μὲν οὐκ ἔνι. εἶδος here and in the next line has the old geometrical signification 'regular figure', as is shown by the explanation. It is *because* you cannot specify a *structure* for the particles which give out the smells that you cannot classify their smells. T. does not regard the division into pleasant and unpleasant smells, 'odours' and 'stinks', as a classification. This is because it is not based on a known 'objective' character of the bodies which have the smells; it is 'subjective', and varies with the individual percipient. The smell which attracts one repels another, and hence the impossibility of really saying whether a given smell is a 'fragrance' or a 'stink'. But a scientific classification cannot be founded on individual likes.

ib. ἡμιγενές. The metaphor is that a smell is a 'half-breed', like a mulatto or a mule; it arises neither from water nor from air (neither from a liquid nor from a gas), but from something not more precisely definable which is half-way between the two. If we apply the language of the *Philebus* to the case, we may say of ὀσμαί what is said there of

ἡδοναί; they are connected only with γένεσις, not with οὐσία. To become air or water is a γένεσις εἰς οὐσίαν, ending in the production of an οὐσία which is the combination of ἄπειρον and πέρας. But this οὐσία, the air or water, has, according to the present theory, no smell. It is only while the γένεσις is incomplete, and its πέρας not yet established, while the contents of a certain region of the ὑποδοχή are 'non-descript', that a smell is given off. Smells, like ἡδοναί, thus exhibit ἀπειρία. As the octahedra (e. g.) change into icosahedra they go continuously through an 'infinity' of momentary phases, and all the while there is a smell; it is not connected with any one of these phases but belongs to the whole ἀπειρία of them. As soon as the octahedra have settled down to a 'regular' shape again, the smell has vanished.

66 d 7–8. βρεχομένων . . . θυμιωμένων. The βρεχομένων and τηκομένων refer to the passage from air to water, the σηπομένων and θυμιωμένων to the opposite process of vaporization which is thought of as conversion into 'air'.

66 e 1. ἐν τῷ μεταξύ. The μεταξύ is thought of by Timaeus exactly as in modern times we think of a 'bounded interval' in a continuous series as having a definite first and last term but no terms which are 'immediately next' one another.

66 e 2. καπνὸς ἢ ὁμίχλη. Note again the view, which comes from Anaximenes, that 'mist' and 'vapour' are intermediate stages in the condensation of air into water and the rarefaction of water into air. Similar is the view of Heraclitus, according to whom καπνός is the first step of fire which is taking the ὁδὸς κάτω, and mist and vapour apparently the first stages in the ascent of earth or water taking the ὁδὸς ἄνω which leads to fire (*EGPh.*[3] 146–50 and references given there). The doctrine is not really consistent with the Empedoclean theory of the four ultimate 'roots', but it is exactly right in the mouth of Timaeus who is trying to fuse the biology of Empedocles, a doctrine based on the 'four roots', with Pythagoreanism, a system which started in its cosmology from the general view of the world given by the Milesians. It is just the great Pythagorean thought on which mathematical physics is based, the thought that the properties of particles depend on their geometrical structure, which makes it possible for Timaeus to get rid of the 'irreducibility' of the 'roots'. But it is not easy to understand how the present theory, which requires an indefinite plurality of intermediate stages between water and air, is to be reconciled with the view of 56 d—57 c which assumes that particles can only be broken up κατὰ τὰ τρίγωνα. The physics and the biology will not really fuse successfully. A.-H. tries to get out of the difficulty by suggesting that the principles laid down in 56 d—57 c do not apply to ὁμίχλη and καπνός which are 'matter in an unformed state'. This amounts to reading into the dialogue Aristotle's doctrine of πρώτη ὕλη, which, as A.-H. himself has rightly insisted, is expressly excluded by the identification of the ὑποδοχή with χώρα.

67 a 1. δύ' οὖν, A W Y, is clearly the true reading, the δεῖ of F being a mere blunder due to 'itacism'. The δι' of Stobaeus (accepted by A.-H.) spoils the sense, which is that you *can* divide the 'nameless varieties' into two sets, the 'nice' and the 'nasty' (cf. διχῇ in a 2), but neither set, as a set, has a name in Greek, and the division is no true

scientific classification. The *ἀνωνύμα* goes along with *δύο* as part of the 'complement'. The sense is 'The varieties of these smells form two sets, neither of which has a name'. T. is not referring to the familiar fact that *particular* smells have not special names of their own as particular colours or tastes have. He means that there is in Greek no distinctive name either for 'fragrance' or for 'stink'. There is only the one word *ὀσμή* for both. *ὄζειν* and *ὀσμή* have to be used alike of a rose and of a piece of carrion. He would not regard such a word as *δυσωδία* as a 'name', since it merely means an *ὀσμή* which the speaker does not like.

67 a 2. οὐκ ἐκ πολλῶν οὐδὲ ἁπλῶν εἰδῶν ὄντα. That is, not only can you not specify a 'simple' or 'regular' form corresponding to each nice or nasty smell, but you cannot make an enumeration of either 'nice' smells or 'nasty' ones as consisting of a definite number of sub-varieties. You could not e. g. say that there are just ten or just twenty 'bad smells'. If you tried to 'classify' them you would not be able to establish a precise number of *infimae species*. He does not mean that there are 'not many' pleasant or unpleasant smells.

T.'s theory closely resembles that of Empedocles. The *Placita* (iv. 17, *Doxogr. Graec.* 407) record only two theories about smell, those of Alcmaeon and Empedocles. Of Alcmaeon we are told simply that he said that we smell with the brain which draws up the smells by means of breathing (or the respiratory openings, *ἐν τῷ ἐγκεφάλῳ εἶναι τὸ ἡγεμονικόν, τούτῳ οὖν ὀσφραίνεσθαι ἕλκοντι διὰ τῶν ἀναπνοῶν τὰς ὀσμάς*). Empedocles said also that smells are drawn in along with the air we take into our lungs. For we see that when respiration is difficult, as in the case of persons with a cold in the head, the subject cannot smell (ib. iv. 17. 2 *ταῖς ἀναπνοαῖς ταῖς ἀπὸ τοῦ πνεύμονος συνεισκρίνεσθαι τὴν ὀσμήν· ὅταν γοῦν ἡ ἀναπνοὴ βαρεῖα γένηται κατὰ τραχύτητα μὴ συναισθάνεσθαι ὡς ἐπὶ τῶν ῥευματιζομένων*). Theophrastus says of Alcmaeon's view (*de Sensu* 25, *Doxogr. Graec.* 506) *ὀσφραίνεσθαι δὲ ῥισὶν ἅμα τῷ ἀναπνεῖν ἀνάγοντα τὸ πνεῦμα πρὸς τὸν ἐγκέφαλον*. His account of Empedocles is (ib. 9, *Doxogr. Graec.* 502) *ὄσφρησιν δὲ γίνεσθαι τῇ ἀναπνοῇ· διὸ καὶ μάλιστα ὀσφραίνεσθαι τούτους οἷς σφοδροτάτη τοῦ ἄσθματος ἡ κίνησις· ὀσμὴν δὲ πλείστην ἀπὸ τῶν λεπτῶν καὶ τῶν κούφων ἀπορρεῖν*. Thus both authors seem to have dealt more with the process of smelling than with the nature of the things which 'smell'. It is noticeable that though Timaeus holds Alcmaeon's theory of the central importance of the brain, he does not actually mention it in the present connexion. This indicates that he is more particularly thinking of Empedocles in this part of his theory. He also reproduces, in a slightly different form, Empedocles' observation about the difficulty of smelling when the process of inhalation is obstructed (66 e 5 ff.). The correspondence with Empedocles should have saved Martin from his curious slip about *τινὸς ἀντιφραχθέντος*. He actually regards the words as masculine, and supposes that T. means to say that if one man breathes through a cloth and a second inhales the breath of the first, as it comes to him through the cloth, it reaches him devoid of any odour. He quotes Galen as understanding the words in this way, but if Galen really took this to be the meaning, he simply made a grotesque blunder. *τινός* is neuter, and the phrase means 'if an obstruc-

tion is put in the way'. Theophrastus certainly understood the words thus, for he paraphrases them in his statement of what he calls Plato's view (*de Sensu* 85, *Doxogr. Graec.* 525) by *ὅταν ἐπιφράξαντες ἀναστῶσιν*, 'when men inhale through an obstacle'. Theophrastus criticizes the whole type of theory in connexion with Empedocles at *de Sensu* 21–2 (*Doxogr. Graec.* 505). He maintains, as a fundamental objection, that some creatures who do not breathe have a sense of smell (*ἔνια ὅλως οὐδ' ἀναπνέει τῶν ὀσφραινομένων*). This seems to be based on Aristotle *de Sensu* 444^{b} 7 ff., which gives as examples fishes, insects (especially bees and ants), and shell-fish. Aristotle is right in saying that fishes and insects are in many cases attracted to their food by smell, but mistaken in his view that they do not breathe. The consequence of this view is that he and Theophrastus hold that though there is a connexion between respiration and smell, the two are only conjoined *per accidens*. Creatures which breathe do also incidentally smell by drawing in the odorous matter in the act of inhaling, but other creatures breathe without respiration. They also ridicule the statement by Empedocles that those who breathe fastest and deepest have the keenest sense of smell. Theophrastus urges (*de Sensu* 21, *Doxogr. Graec.* 505) that if the olfactory organs are diseased or injured you may breathe as fast and deep as you please but your sense of smell will be defective. Also that on E.'s view short-winded persons and men who are doing hard bodily work or are asleep ought to be specially sensitive to smells, as they inhale most air. But in fact they are less sensitive than others. He also denies the statement of E. that 'light' bodies are most highly odorous, on the ground that neither air nor fire has any distinctive smell. Th. informs us (*de Sensu* 28, *Doxogr. Graec.* 507) that Anaxagoras followed the theory of Alcmaeon in connecting smelling with breathing, and so also (*de Sensu* 41, *Doxogr. Graec.* 510–11) did Diogenes of Apollonia, adding that those whose brains contain least air and those whose respiratory passages (perhaps he means the olfactory nerves) are very long and narrow are most keen-scented.

Aristotle discusses the subject both in the *de Anima* and in the special essay *de Sensu*. In the *de Anima* (B. 421^{a} 7—422^{a} 7) he begins by saying that in man this sense is defective, and hence we cannot distinguish well-marked kinds of smells. We hardly perceive a smell at all unless it is pronouncedly pleasing or disgusting (*τὴν αἴσθησιν ταύτην οὐκ ἔχομεν ἀκριβῆ, ἀλλὰ χεῖρον πολλῶν ζώων· φαύλως γὰρ ἄνθρωπος ὀσμᾶται, καὶ οὐθενὸς ὀσφραίνεται τῶν ὀσφραντῶν ἄνευ τοῦ λυπηροῦ ἢ τοῦ ἡδέος*, 421^{a} 9–12). This looks like a conscious allusion to what Timaeus says at 67 a 1-3. But there is a general correspondence between smells and tastes. There are sweet, pungent, tart, sour, bitter smells, as well as tastes (*ἔοικε μὲν γὰρ ἀνάλογον ἔχειν πρὸς τὴν γεῦσιν καὶ ὁμοίως τὰ εἴδη τῶν χυμῶν τοῖς τῆς ὀσμῆς, ἀλλ' ἀκριβεστέραν ἔχομεν τὴν γεῦσιν*, 421^{a} 16–19). This is an interesting observation, but Aristotle's explanation seems to invert the facts. According to modern psychologists, human taste is even more defective than human smell; what we usually call the 'tastes' of things are really smells complicated with feelings of touch, except for the four or five well-marked genuine tastes, sweet, salt, sour, bitter. Ar. goes on to maintain that though we can only smell by in-

haling, 'bloodless' creatures smell without breathing (*τὸ ἄνευ τοῦ ἀναπνεῖν μὴ αἰσθάνεσθαι ἴδιον ἐπὶ τῶν ἀνθρώπων· δῆλον δὲ πειρωμένοις· ὥστε τὰ ἄναιμα, ἐπειδὴ οὐκ ἀναπνέουσιν, ἑτέραν ἄν τιν' αἴσθησιν ἔχοι παρὰ τὰς λεγομένας· ἀλλ' ἀδύνατον, εἴπερ τῆς ὀσμῆς αἰσθάνεται*, 421^{b} 18–22). Smells are peculiar to 'dry' substances, as tastes are to 'moist'. They, like the other objects of immediate sense-awareness, are more fully treated in the *de Sensu*, where they are the subject of c. 5 (442^{b} 27—445^{b} 2). The specific object of smell is *τὸ ἔγχυμον ξηρόν*, the 'sapid dry'. Air, and as he thinks water, transmit smells because they 'rinse' this sapid dry substance (*ἔστι δ' ὀσφραντὸν* ⟨sc. *τὸ διαφανές*, which includes both air and water⟩ *οὐχ ᾗ διαφανές, ἀλλ' ᾗ πλυντικὸν ἢ ῥυπτικὸν ἐγχύμου ξηρότητος*, 442^{b} 30). Hence *ὀσμή* is defined as 'the sapid dry diffused in a moist medium' (*ἐν ὑγρῷ τοῦ ἐγχύμου ξηροῦ φύσις*, 443^{a} 7). But he expressly denies that a smell is either a 'smoke-like' (*καπνώδης*) or a 'watery' exhalation, obviously intending a polemical reference to Timaeus among others. Thus he says (443^{a} 21) *δοκεῖ δ' ἐνίοις ἡ καπνώδης ἀναθυμίασις εἶναι ὀσμή, οὖσα κοινὴ γῆς τε καὶ ἀέρος*, and at 443^{a} 25 mentions the view that *ὀσμή* is *ἀτμίς*, 'moisture'. The first view is rejected, primarily because *ὀσμᾶται δὲ καὶ τὰ ἐν τῷ ὕδατι* (443^{a} 31); the second is inconsistent with his view that *τὸ ὀσφραντόν* is always *τὸ ἔγχυμον ξηρόν*. The type of theory given by Timaeus is, in fact, held to stand or fall with the more general doctrine that perception is due to *ἀπόρροιαι*, 'effluences', and that doctrine Aristotle holds he can show to be false (*ἡ ἀναθυμίασις ὁμοίως λέγεται ταῖς ἀπορροίαις· εἰ οὖν μηδ' ἐκείνη καλῶς, οὐδ' αὕτη καλῶς*, 443^{b} 1). Aristotle goes on to deny, with an obvious allusion to the *Timaeus*, the statement that there are no *εἴδη* of smells; there are, he says, two (loc. cit. 443^{b} 17 *εἴδη δὲ τοῦ ὀσφραντοῦ δύο ἐστίν· οὐ γὰρ ὥσπερ τινές φασιν, οὐκ ἔστιν εἴδη τοῦ ὀσφραντοῦ, ἀλλ' ἔστιν*). There are (*a*) the smells of which he has chiefly spoken, those which are analogous with tastes and attract animals to their food, and (*b*) those which are entirely disconnected with tastes; in fact those which have a 'survival-value' for the organism, an 'extrinsic' value as pointing to *τροφή*, and those which have no survival-value and point to nothing, but have an *intrinsic* value in their own agreeableness, like the smells of perfumes (loc. cit. 443^{b} 19 *τὸ μὲν γάρ ἐστι κατὰ τοὺς χυμοὺς τεταγμένον αὐτῶν . . . καὶ τὸ ἡδὺ καὶ τὸ λυπηρὸν κατὰ συμβεβηκὸς ἔχουσιν· διὰ γὰρ τὸ θρεπτικοῦ πάθη εἶναι, ἐπιθυμούντων μὲν ἡδεῖαι αἱ ὀσμαὶ τούτων εἰσί, πεπληρωμένοις δὲ καὶ μηδὲν δεομένοις οὐχ ἡδεῖαι . . . αἱ δὲ καθ' αὑτὰς ἡδεῖαι τῶν ὀσμῶν εἰσίν, οἷον αἱ τῶν ἀνθῶν*). Man, Aristotle thinks, is the only being sensitive to smells of this second class, and he is sensitive to them because his brain is by nature 'cold' and the blood in it easily congealed. The smell of flowers, perfumes, &c., is beneficial as counteracting this tendency (loc. cit. 444^{a} 8 ff.). This distinction between the two sorts of smells seems a valuable contribution to the psychology of the subject and possibly arose from reflection on the very fact already mentioned by Timaeus about the 'purity' of the pleasures of sweet smells. Ar. also mentions that some Pythagoreans believed that there are creatures which live on smells alone (loc. cit. 445^{a} 16). He is at pains to refute this theory, which is not mentioned by Timaeus.

67 a 4–6. **τὸ μὲν τραχῦνον . . . ἀποδιδόν.** The account of smells is thus brought into line with the general theory of pleasure and pain. The 'nasty' smells 'rumple' the whole of the internal system from the crown of the head to the navel, thus setting up an unnatural condition; the nice smells quiet these organs by a sort of internal massage (*καταπραῦνον*) and restore us to normality. The restriction of the effects of the bad smells to the parts above the navel seem based on empirical considerations. Some of them 'go to our heads' and make us feel dizzy, others make us feel sick. They do not act directly on the *κάτω κοιλία*, and give no diarrhoea. However, since at 70 e 1 the navel is mentioned as the boundary of the tenement devised for the *ἐπιθυμητικόν*, the result is that smells affect the whole 'seat of the soul' from one end to the other.

67 a 7–c 3. **τρίτον δὲ . . . ῥηθῆναι.** *Hearing.* Once more we begin by an attempt to define the immediate object of this kind of sense-awareness, *φωνή*, 'sound'; a word which in Aristotle's more developed terminology means 'voice', as contrasted with *ψόφος*, mere 'noise' (*de Anima* B. 420^{b} 5 *ἡ δὲ φωνὴ ψόφος τίς ἐστιν ἐμψύχου· τῶν γὰρ ἀψύχων οὐθὲν φωνεῖ*. And, he goes on to say, many *ἔμψυχα* also have no *φωνή* either; in the end *φωνή* is confined by him to the sound made by the vibrating larynx and the members connected with it). Aristotle's distinction is a little badly drawn for the purposes of sense-psychology. It is important to distinguish *tone* from mere noise, but irrelevant to the psychology of hearing how the tone heard is produced. Plato is using the word, as the context shows, generically for 'sound'. Sound, then, is a stroke or blow (*πληγή*) given by the air, through the ear, to the brain and blood and transmitted to the soul. There is an ambiguity of construction and consequently of translation in this definition. The question is whether *ἐγκεφάλου* and *αἵματος* are governed by *διά*, so that the sense is that *φωνή* is a 'stroke by the air passed on by means of the ears, brain, and blood to the soul'—this was Stallbaum's view of the passage—or should be regarded as 'objective genitives' after *πληγήν*, so that the meaning will be 'a stroke given by the air through the ears to the brain and blood, passed on until it reaches the soul'. That, is what does the air strike 'through the ears'? Does it strike the *ψυχή*, the brain and blood being regarded, like the ears, as mere instruments of the blow? or does it, in the first instance, strike the brain and blood themselves? A discussion of the matter will be found in C. W., op. cit., pp. 99–100, where it is admitted that A.-H. may be right, as against St., in taking the second view, though, as C. W. says, the reason he alleges, viz. that on St.'s theory the 'hyperbaton' of *ὑπ' ἀέρος* is objectionable, will not stand examination. C. W. also urges that the *Placita* construe the words in St.'s way (*Aetii Placita* iv. 16. 4, *Doxogr. Graec.* 406 *Πλάτων καὶ οἱ ἀπ' αὐτοῦ πλήττεσθαι τὸν ἐν τῇ κεφαλῇ ἀέρα· τοῦτον δ' ἀνακλᾶσθαι εἰς τὰ ἡγεμονικὰ καὶ γίνεσθαι τῆς ἀκοῆς τὴν αἴσθησιν*). I do not think the authority of the *Placita* on a point of Platonic grammar appreciable, and in this case it looks as though his meaning had been quite misunderstood, since he is represented as speaking of a blow given to the 'air in the head'. It is not clear whether this means air in the external meatus of the ear or, as I suspect, air actually in the brain. My own suspicion is that we are

dealing with an explanation of a corrupt text from which the *ὑπό* before *ἀέρος* had disappeared, so that the words could only be understood to mean a 'blow' given to air in the interior of the head. But even if air in the external ear is meant, the explanation of the *Placita* assumes Plato to say nothing about the way in which it is originally agitated. He is assumed to be speaking of the air as *receiving* a stroke, when it is surely plain that he is really speaking of the air round us as *giving* a stroke to us. On the other side, as C. W. admits (op. cit., p. 63), Theophrastus twice alludes to the words in a way which shows that he took A.-H.'s view of the construction (*de Sensu* 6, *Doxogr. Graec.* 500 *φωνὴν γὰρ εἶναι πληγὴν ὑπ' ἀέρος ἐγκεφάλου καὶ αἵματος δι' ὤτων μέχρι ψυχῆς*, ib. 85, *Doxogr. Graec.* 525 *φωνὴν δὲ εἶναι πληγὴν ὑπὸ ἀέρος ἐγκεφάλου καὶ αἵματος δι' ὤτων μέχρι ψυχῆς*). And the *τε καί* in *ἐγκεφάλου τε καὶ αἵματος* should naturally go together. Hence I do not feel much doubt that the construction of Theophrastus and A.-H. is right. The meaning then is that the stimulus in the case of sound is a vibration in the air which is communicated through the ear in some way to the 'brain and blood' and so reaches consciousness. As for the part played by the blood, it will, I think, appear later on that this means that the disturbance is communicated by the brain to the blood in the blood-vessels and finally reaches the liver, as Timaeus says in b 5 (*τελευτῶσαν δὲ περὶ τὴν τοῦ ἥπατος ἕδραν*). Why the liver should be brought in we shall understand better when we have heard what Timaeus has to say about the functions of that organ at p. 71. It is supposed to be specially the seat of the *ἐπιθυμητικόν*, and presumably the continuance of the reaction in hearing to that region is meant to account for the shock unfamiliar noises or those which indicate the presence of something hostile to the organism, and some others (e. g. the squeak of a pencil on a slate), give to the whole bodily system.

67 b 6. *ὅση δ' αὐτῆς . . . βαρυτέραν.* This is verbally a correct statement. Rapid vibrations in the air give rise to sounds of high pitch, less rapid to sounds of lower pitch. But we shall see (80 a 3–b 5) that T.'s views on the velocity involved are confused. He confuses rate of vibration with rate of transmission of vibration, supposing that the more rapid vibrations are propagated through the air with a greater velocity. This is a delusion. All vibrations are propagated with the same velocity in a uniform medium, and thus the pitch of a note has no more to do with the rate at which sound travels than the colour of a ray of light with the rate at which light travels.

67 b 7–8. *τὴν δὲ ὁμοίαν . . . σμικράν.* 'Uniform' wave-motion gives rise to a 'uniform and smooth sound', i. e. to a tone with a single definite pitch; irregular motion to a 'rough' sound, a *noise* of no definite pitch. The loudness of the sound depends on the 'amplitude' of the vibrations.

67 c 2–3. *τὰ δὲ . . . ῥηθῆναι.* The reference is to 80 c *infra*. The *αὐτῶν* probably means *τῶν φωνῶν* but may mean *τῶν πληγῶν*. *συμφωνία* does not refer to 'concord' or 'harmony', but to capacity for being combined into melodic progressions.

T.'s account of hearing should be carefully compared with the accounts in Theophrastus and the doxographies based on him of the early theories of the subject. Alcmaeon seems to have laid down the general lines of

the theory, and once more Timaeus is following him and Empedocles closely. Of Alcmaeon Theophrastus says in the *de Sensu*—over and above the general statement that he connected sensation with the brain—that he said, 'we hear with our ears because there is void in them, for this is what is resonant (op. cit. 25, *Doxogr. Graec.* 506 *ἀκούειν μὲν οὖν φησι τοὺς ὠσίν, διότι κενὸν ἐν αὐτοῖς ἐνυπάρχει· τοῦτο γὰρ ἠχεῖν*). The hollow cavity makes a noise and this is re-echoed by the air (*φθέγγεσθαι δὲ τῷ κοίλῳ, τὸν ἀέρα δ' ἀντηχεῖν*).' On this clause see Stratton *Greek Physiological Psychology* n. 77 in loc. and Beare *Greek Theories of Elementary Cognition* 93 n. 2. Diels originally regarded the words as corrupt, but in *Fr. d. Vors.*[3] i. 132 retains them, marking off *φθέγγεσθαι . . . κοίλῳ* as a parenthesis. If the words are sound, I suppose the 'air' which *ἀντηχεῖ* to be that within the cavity of the ear itself. It is possible that this is the explanation of the misleading notice in the *Placita* about Plato's theory of hearing. Empedocles' account comes to much the same thing: 'hearing arises from noises within the head, when the air, set in motion by a sound, resounds within' (Theophr. *de Sensu* 9, *Doxogr. Graec.* 501 *τὴν δ' ἀκοὴν ἀπὸ τῶν ἔσωθεν γίνεσθαι ψόφων, ὅταν ὁ ἀὴρ ὑπὸ τῆς φωνῆς κινηθεὶς ἠχῇ ἐντός*. I have given the words not as they stand in the MSS. or are printed in Diels' edition of the *Doxographi*, but as restored in *Fr. d. Vors.*[3] i. 217. The MSS. have *ἔξωθεν* for *ἔσωθεν* and *γὰρ* for *ὁ ἀήρ*, but neither reading seems defensible.) T.'s theory is evidently constructed on these models. Anaxagoras also explained (Theophr. op. cit. 28, *Doxogr. Graec.* 507) that we hear *ἅμα τῷ διικνεῖσθαι τὸν ψόφον ἄχρι τοῦ ἐγκεφάλου· τὸ γὰρ περιέχον ὀστοῦν εἶναι κοῖλον, εἰς ὃ ἐμπίπτειν τὸν ψόφον*, 'when the noise penetrates to the brain, for the bone containing the brain (i.e. the skull) is hollow, and it is on this that the noise strikes'. (The thought is that just because the skull is hollow it is readily set vibrating.) Similarly Diogenes of Apollonia (op. cit. 40, *Doxogr. Graec.* 510), 'hearing arises when the air internal to the ear is moved by the external air and transmits the motion to the brain' (*τὴν δ' ἀκοήν, ὅταν ὁ ἐν τοῖς ὠσὶν ἀὴρ κινηθεὶς ὑπὸ τοῦ ἔξω διαδῷ πρὸς τὸν ἐγκέφαλον*). The statements of the *Placita* (iv. 16, *Doxogr. Graec.* 406) are mere summaries of this information.

Aristotle's account of sound and hearing will be found in *de Anima* B. 419[b] 4—421[a] 6. Sound is caused when a body, particularly a smooth and hollow one, is struck and set vibrating and communicates the vibrations to the surrounding air or water (op. cit. 419[b] 6 *τὰ μὲν γὰρ οὔ φαμεν ἔχειν ψόφον . . . τὰ δ' ἔχειν, οἷον χαλκὸν καὶ ὅσα στερεὰ καὶ λεῖα, ὅτι δύναται ψοφῆσαι. . . . γίνεται δ' ὁ κατ' ἐνέργειαν ψόφος ἀεί τινος πρός τι καὶ ἔν τινι· πληγὴ γάρ ἐστιν ἡ ποιοῦσα. . . . πληγὴ δ' οὐ γίνεται ἄνευ φορᾶς· ὥσπερ δ' εἴπομεν, οὐ τῶν τυχόντων πληγὴ ὁ ψόφος· οὐθένα γὰρ ποιεῖ ψόφον ἔρια ἂν πληγῇ, ἀλλὰ χαλκὸς καὶ ὅσα λεῖα καὶ κοῖλα . . . . οὐκ ἔστι δὲ ψόφου κύριος ὁ ἀὴρ οὐδὲ τὸ ὕδωρ· ἀλλὰ δεῖ στερεῶν πληγὴν γενέσθαι πρὸς ἄλληλα καὶ πρὸς τὸν ἀέρα*). This last sentence is aimed at all such theories as Alcmaeon's. Aristotle's point is that the air is only the 'medium' of transmission, not the 'agent' in the production of sound. You should begin with a *πληγή* of e.g. metal on metal transmitted by the air. The vibrations of the air or water (Aristotle rightly rejects the view that sound is propagated only in air) are then the immediate stimulus in hearing.

The vibration of the medium imparts a corresponding vibration to the air contained within the ear (op. cit. 420ª 4 *ἀκοὴ δὲ συμφυὴς ἀέρι· διὰ δὲ τὸ ἐν ἀέρι εἶναι, κινουμένου τοῦ ἔξω ὁ εἴσω κινεῖται*). This account thus follows much the same lines as the older ones, but (*a*) the source of the *πληγή* transmitted by the medium is specified, (*b*) it is recognized that air is not the only medium for the transmission of sound, (*c*) no reference is made to any part played in the process by the brain.

67 c 4—68 d 7. **Τέταρτον δὴ λοιπὸν . . . εἰς αὖθίς ποτε ἔσται.** *Colour.* This section presents exceptional difficulties mainly due to the uncertainty of identification of several of the tints mentioned. For the most part we have to find out what the Greek name of a colour means by seeing to what objects it is applied in literature, and this is necessarily a very conjectural business. To do the work well would require such a complete knowledge of the uses of these names from the earliest to the latest literature as can hardly be possessed except by a specialist. Again, even if one had all the information before one, it would be very hard to tell whether in many cases the application of a particular epithet to a particular object may not have become purely conventional from a very early date, or whether different writers really mean the same tint when they use the same word. Not to say that much depends on the accuracy of colour-vision of the particular writer. (Byron, according to Trelawny's *Records*, maintained that no one ever saw a green sky. If Byron was in earnest, his eye for colour must have been badly defective, or he must have looked in the wrong places.) But a still graver difficulty, to my mind, is that the Greeks did not make the 'cuts' in the colour-continuum marked by distinct names exactly where we do. Thus among the things the Greeks called *χλωρά* there are some of which we should speak as pale or greenish yellow and others we should more usually call yellowish or golden green. The transition from orange through yellow and green to blue in the spectrum is continuous, and it is thus largely arbitrary just where you should pass from using one and the same colour-epithet to employing a fresh one. There is also the difficulty suggested by our uncertainty whether a difference in colour-names in Greek is meant primarily to indicate a difference in tint or one in brilliancy and lustre. Again, statements about the results of colour-mixtures, of which Timaeus makes several, are further complicated by the uncertainty whether the mixtures are supposed to be got by superposing differently coloured lights or by mingling different pigments. The two methods lead to very discrepant results. For all these reasons this particular section of the dialogue is perhaps the one of all others that we must never expect to understand fully. There are exactly the same difficulties about the interpretation of the colour-equations of Democritus reported by Theophrastus in the *de Sensu*. Timaeus himself is careful to insist with exceptional emphasis on the purely provisional character of this part of his lecture (67 d 1 *μάλιστα εἰκὸς* κτλ., 68 b 6 *τὸ δὲ ὅσον μέτρον ὅσοις, οὐδ' εἴ τις εἰδείη, νοῦν ἔχει τὸ λέγειν* κτλ., 68 d 2 *τὸν εἰκότα μῦθον*, and note the strong disclaimer of certainty with which the whole section ends, 68 d 2–7). It is clear that he feels less confident here than anywhere else, and that he would not be seriously perturbed if he could be told that all his 'conjectures' were

wrong. The main points of the theory are that colour is a 'flame' or 'light' (φλόξ) emanating from the coloured body, and that differences in colour correspond to differences in the result of the encounter between this flame and the ὄψις or ray of light issuing from the eye (which, it must be remembered, is itself a kind of fire). Everything turns on the συμμετρία between the visual stream and the particles of flame emitted by the coloured body. Thus Timaeus is definitely adopting the Empedoclean doctrine of colour-perception as due to the entrance of particles into the πόροι or passages of the organ of sight, the particles being ἀπόρροιαι, effluxes, from the coloured body, in fact particles of fire, as they must be if we grant the premisses that the real organ of vision is itself a 'flame' or ray of light and that 'like is known by like'. A.-H.'s denial that the doctrine of Timaeus reproduces Empedocles is mistaken.

67 c 8–d 1. ὄψεως . . . ἐρρήθη. Constr. *αὐτὸ ἐρρήθη περὶ τῶν αἰτίων τῆς γενέσεως ὄψεως ἐν τοῖς πρόσθεν*, 'the bare fact (just the fact and nothing more) about the causes of vision has already been mentioned', a reference to 45 b 4 ff. The *αὐτό* or 'bare fact' is contrasted with the fuller statement about the details of the process now to be given. The evidence of A F and Stobaeus puts it beyond all doubt that *αὐτό* was the archetypal reading, and it yields exactly the sense needed. The *αὐτῶν* of Y[1], read by Bekker, St., M., and the Zürich editors, has no weight against this consensus of authorities, and gives a false emphasis to *τῶν αἰτίων*. Schneider's conjecture *αὖ τό*, which makes *τὸ περὶ τῶν αἰτίων τῆς γενέσεως ὄψεως* subject to *ἐρρήθη* would be good enough if the *αὐτό* of the best MSS. tradition were not better still.

67 d 1–e 4. τῇδ' οὖν . . . τὰς αἰτίας. The theory, as now developed, is this. The particles of flame emitted from an object which form its colour, and mingle with those of the visual ray issuing from the eye, may be exactly equal in bulk to the particles composing the visual ray or they may not. (In any case the particles of both are identical in form; being fire, they are tetrahedra.) If the emitted particles are exactly equal to those of the visual ray in bulk, the object seen appears transparent. If they are unequal, the object seen ⟨intercepts the visual ray and⟩ is seen as coloured, the particular colour depending on the sense of the inequality. Particles smaller than those of the ὄψις can cut into it and divide it; larger particles compress or squeeze it laterally. So the fundamental colour-opposites are the pair 'divisible of the visual current' (*διακριτικὸν ὄψεως*), and 'squeezing the visual current' (*συγκριτικὸν ὄψεως*). These answer to the colours *λευκόν* and *μέλαν* respectively. *White* is that which divides the visual current, a definition repeatedly used as an illustration to Aristotle's *Topics*, black that which squeezes or compresses it. Thus there is an analogy between white and black on the one hand and warmth and cold on the other, since warmth is supposed to 'prick' or 'cut' the flesh, cold to make it contract, and again between black and the astringent (*στρυφνά*) tastes which contract the passages in the mouth and white and the pungent warm tastes (*δριμέα*) which heat and prick them. The analogy is, however, commonly overlooked (*φανταζόμενα δὲ ἄλλα*, 67 e 3), because colours and tastes are not in the same *γένος*. Timaeus thus

[1] Indicated also by W's *αὐτῷ*.

treats colours as a linear series of which white and black are the two end-terms, just as Aristotle and Goethe did after him.

67 d 5. τὰ μὲν οὖν ἴσα ἀναίσθητα. This is because the particles emitted from the object are in this case absolutely indistinguishable from those of the visual ray itself. Hence you seem to see right through the object, and that is why it gets the epithet διαφανές. The δή (ἃ δὴ καὶ δ. λέγομεν) means about 'of course'. 'Of course' you call such a thing 'translucent'.

ib. **5–7.** τὰ δὲ μείζω . . . αὐτήν. It is the particles which are smaller than those of the ὄψις which penetrate it, those which are larger that squeeze it. In the following clauses the θερμοῖς and ψυχροῖς answer chiastically to the συγκρίνοντα and διακρίνοντα, στρυφνοῖς—δριμέα are then made to correspond by a second chiasmus to ψυχροῖς and θερμοῖς, and so the original order is restored again.

67 e 2. τά τε λευκὰ καὶ τὰ μέλανα. Again a chiastic arrangement, since it is the λευκά which correspond to the δριμέα and the μέλανα which answer to the στρυφνά.

67 e 2–3. ἐκείνων. St. says '*alba et nigra quae sunt illorum affectiones.* Intell. autem illorum quorum modo mentionem fecit, videlicet calidorum et frigidorum, acerborum et acrium'. This cannot well be right. It is not universally true that θερμά are white and ψυχρά black, for ice is white. And it is certainly not true that δριμέα are white and στρυφνά black. A.-H. takes ἐκείνων to refer to τὰ συγκρίνοντα and τὰ διακρίνοντα, and this appears to me to be correct; the three qualities θερμόν, δριμύ, λευκόν are all παθήματα of one kind of body, that which 'cuts' the organs of sense, their three opposites ψυχρόν, στρυφνόν, μέλαν are all παθήματα of another kind of body, that which compresses them.

67 e 5. τὸ μὲν διακριτικὸν τῆς ὄψεως λευκόν. This seems to have become the accepted Academic definition; cf. for references to it Aristotle *Topica* A. 107^{b} 29, Γ. 119^{a} 30, Δ. 123^{a} 2, H. 149^{a} 38.

67 e 6—68 b 1. τὴν δὲ ὀξυτέραν . . . ἐπωνομάσαμεν. We come now to the explanation of the intermediate colours. The first of them is τὸ λαμπρόν or τὸ στίλβον, and into the account of this is inserted an explanation of the effects of bright lights in dazzling us and making our eyes water. Suppose the flame emitted from an object is moving with a high velocity, and that its particles, being smaller than those of the visual ray, in virtue of this high velocity 'split' the ray right up to the eye itself and so come into contact with and act on the actual passages (διέξοδοι) in the eye; they will heat and dissolve the substance of these passages and so express from them (ἐκχέουσαν, 68 a 2) a conglomerate of fire and water, the warm wet thing we all call a tear. When this happens, fire is, on the one hand, 'leaping from the eye', on the other hand fire emitted from the object is forcing its way in and is then being put out by the 'humours' in the eye. In this general state of confusion (κύκησις) we see all kinds of colours, and are said to be 'dazzled'; the object which sets up the process is called λαμπρόν or στίλβον, 'brilliant', 'bright'. So far it is clear that what is being described is not really a new hue or tint. It is simply the blinding and dazzling effect of powerful and brilliant light of which Timaeus is thinking.

67 e 6–7. τὴν δ' ὀξυτέραν φορὰν καὶ γένους πυρὸς ἑτέρου προσπίπτουσαν.

What does ἑτέρου mean? Different from what? A.-H. says from the light which has just been described as white. But does not white light, if brilliant enough, produce the dazzling effects described? It seems to me, therefore, that St. is right in supposing that all that is meant is that the fire is 'different' from that of the visual ray itself. It clearly is; its particles are smaller, for it διακρίνει τὴν ὄψιν. It follows that T. is still speaking of white light, since white has just been defined as τὸ διακριτικὸν τῆς ὄψεως. Hence it is clear that the peculiar dazzling effect is supposed to be due not to any difference of quality from a white light which does not dazzle, but to the superior velocity which enables the particles emitted from the 'dazzling' surface to make their way into the ὄψις and along it μέχρι τῶν ὀμμάτων. In the more ordinary case, we may presume, the current of particles emitted from the object loses its separate identity before it has penetrated so far. It is assumed that the velocity of light is not uniform. It is logically permissible for T. to postulate this, if the assumption enables him to 'save' appearances, and no one in the fifth century B.C. could have produced any reason for thinking such a postulate false.

68 a 1. διωθοῦσαν καὶ τήκουσαν. The high velocity of the particles explains why they 'push asunder', 'force their way into' the διέξοδοι; the τήκουσαν is to be explained by the 'cutting' power ascribed to fire in virtue of the shape of its particles. The sense 'to force one's way through' is more usually expressed by the middle διωθεῖσθαι, but here the context shows that the way in which the ostentatious particles 'force apart' the διέξοδοι is by getting into them. In Eur. *Heraclid.* 995–6 διώσας καὶ κατακτείνας ἐμοὺς | ἐχθρούς the sense seems to be slightly different, 'dividing', 'isolating' my enemies from one another. L. and S. give for our passage the sense 'to stop up', but this must be a mistake.

ib. **πῦρ . . . καὶ ὕδωρ.** M. and A.-H. refer to 59 d 4 τὸ πυρὶ μεμειγμένον ὕδωρ κτλ. It is simpler to point out that what is expressed from the eye must be πῦρ καὶ ὕδωρ because, as we were told in 45 b, there is fire in the centre of the eye, and it is a notorious fact that it is surrounded by 'humours'. And T. supposes us to be aware of the familiar fact that a tear is both warm and wet. The ἀθρόον, of course, qualifies the whole complex πῦρ καὶ ὕδωρ, 'fire and water commingled'.

68 a 4–5. περὶ τὸ νοτερὸν κατασβεννυμένου. This is the ultimate fate of the particles of the external flame which have actually penetrated into the eye. They find themselves surrounded with a much greater bulk of water (viz. the 'humours' of the eyeball), and on T.'s principles will be converted themselves into water. In the course of this process, as the conversion of fire into water advances, there will be a succession of rapidly changing colours. (The underlying thought is that pure fire is white, being διακριτικὸν τῆς ὄψεως, water is notoriously μέλαν ὕδωρ. So in the conversion of the fire into water, the whole colour-scale is run through from one end to the other.) As for the construction of the whole long sentence from 67 e 5 τὸ μέν onwards, τὸ μὲν διακριτικόν, τὸ ἐναντίον, τὴν ὀξυτέραν φοράν are governed by προσείπομεν, but, owing to the interposition of two genitive absolute clauses, by the time we reach the main verb the 'anticipated' object has to be resumed, and in the

resumption is subdivided into the *πάθος* itself and its cause (*τὸ τοῦτο ἀπεργαζόμενον*). Meanwhile it has been forgotten that the *τὸ μὲν πάθος* and *τὸ δὲ τοῦτο ἀπεργαζόμενον* really only take up one of the three anticipatory accusatives, *τὴν ὀξυτέραν φόραν*. The sentence cannot be reduced to any grammatical formula, but it has the kind of syntax which is characteristic of educated speech.

68 b 1–5. *τὸ δὲ τούτων . . . λέγομεν.* Blood-red. The construction and translation of what is said of this colour will depend on the view we take of the text. It is clear that in b 3 we must read *αὐγῇ* for the meaningless *αὐτῇ* of A, and the collation of F W has shown that this was really the archetypal reading. *μειγνυμένου*, originally restored to the text by Stephanus for the *μειγνυμένῃ* of A Y W and Stobaeus, is also the reading of F, and the sense, I think, requires us to adopt it. If we then, like Bt., punctuate with a colon at *οὗ* in b 3 and remove the comma which he retains after *παρασχομένῃ* in b 4, we get a text supported throughout by F which seems to me quite satisfactory. The meaning is 'That which is intermediate between these again (i. e. between *λευκον* and *λαμπρόν*) is a kind of fire which reaches and mingles with the humours of the eye, but is not dazzling'. (That is, *τὸ τούτων μεταξύ* is the subject to an 'understood' *ἐστί* to which *πυρὸς γένος κτλ.* is 'complement'.) Without the colon at *οὗ* the following *παρασχομένῃ* cannot be construed, and hence Lindau, with St.'s approval, 'emended' it to *παρασχόμενον*. But the word was clearly in the archetype, as it is given by A F W Y and has the support of Stobaeus. When the colon has once been introduced, we can 'govern' *παρασχομένῃ* by *τοὔνομα λέγομεν*. 'And to the gleaming of the fire through the moisture with which it is mixed we give the name *ἐρυθρόν*, blood-red.'[1] For the use of the dative cf. *Sophistes* 229 c 8 *καὶ δὴ καὶ τούτῳ γε οἶμαι μόνῳ τῆς ἀγνοίας ἀμαθίαν τοὔνομα προσρηθῆναι*, *Politicus* 279 e 4 *τούτοισι δὴ . . . ἀμυντηρίοις καὶ σκεπάσμασι τὸ μὲν ὄνομα ἱμάτια ἐκαλέσαμεν*. Since the text thus adopted is in every letter attested by first-rate MSS. authority, I see no use in discussing any conjectural departures from it. The only point of uncertainty is whether *τοῦ πυρὸς μειγνυμένου* should be taken as gen. absol. in b 3 or *πυρός* regarded as dependent on *αὐγῇ*, and this is a question which leaves the meaning of the clause unaffected.

As to the theory, we are not told why in this case the 'dazzling' is not produced. Perhaps the particles emitted by the red object, though still smaller than those of the *ὄψις* which they divide, are larger than in the former case, so that fewer of them get into the *ὄψις* and reach the eyes, or perhaps their velocity is lower and the effect on the passages of the eye less violent in consequence. In any case, it is a less extreme effect of the same kind; the fire from the object actually gets into the eye and affects its 'humours', but not sufficiently to express tears. Hence there is no dazzling, but the gleam of the fire through the moisture with which it blends produces *ἐρυθρόν*. That the colour meant is blood-red is indicated by the expression *χρῶμα ἔναιμον*.

68 b 5–8. *λαμπρόν τε . . . δυνατός.* *λαμπρόν* + *ἐρυθρόν* + *λευκόν* is said to be *ξανθόν*. This is an epithet of ripe corn, of gold, of honey, of wines,

[1] Fraccaroli also reads and renders the sentence in what I venture to think the only permissible way.

and of hair. According to Aristotle it comes in the rainbow between red and green. It is thus apparently used for things which we should call bright golden yellow, or varying from this to orange or even brown. We must think of it as, like our 'orange', intermediate between red and a pure yellow, not as a green-yellow. That the name is meant to cover a wide range is shown by Timaeus' remark that it would be in any case foolish to say in what proportions the different constituents are blended.

68 b 8–c 1. ἐρυθρὸν . . . ἀλουργόν. *ἐρυθρόν* + *μέλαν* + *λευκόν* is *ἀλουργόν* Since black + white must mean some shade of grey, this amounts to saying that *ἀλουργόν* is a 'darkened' *ἐρυθρόν*. It is the name of the colour, conventionally called in English 'purple', made by the dye got from the famous Tyrian murex. It is fairly clear that what is now called purple, the shades intermediate between violet and red, is not likely to be what Timaeus is thinking of, but whether he means 'scarlet' or 'crimson' or both could only be settled if we knew the exact shade of red intended by *ἐρυθρόν*. Since *ἐρυθρόν* is the colour of blood, perhaps it is 'crimson' which comes nearest to his meaning.

68 c 1–2. ὄρφνινον . . . μέλαν. The same combination more 'burnt' and with added *μέλαν* gives *ὄρφνινον*. The derivation from *ὄρφνη* indicates that the word means primarily the colour of the sky at night. I should suppose a very deep blue to be intended, but the colour of the night-sky depends so much on circumstances that it is hard to be positive. A.-H. renders by 'violet', and violet does look more like a 'deepened' red than dark blue does. Perhaps at Locri or at Athens the night-sky does look violet? Rivaud says *brun foncé*.

68 c 3. πυρρὸν . . . γίγνεται. *πυρρόν* is *ξανθόν* + *φαιόν* and *φαιόν* is explained to be black + white, i.e. grey. Hence *πυρρόν* is something of an orange or rich yellow but less brilliant than the colour of ripe corn and the like which is *ξανθόν*. What it is is suggested by the regular use of it in speaking of men with sandy or reddish hair (cf. the name Πυρρός), and of the tawny desert beast, the lion. Rivaud, *brun clair*.

68 c 4–5. τὸ δὲ ὠχρὸν . . . μεμιγμένου. *ὠχρόν* is *ξανθόν* with white in it. This should mean that it is a buff or pale yellow ('khaki'?).

68 c 5–6. λαμπρῷ δὲ . . . ἀποτελεῖται. *λαμπρόν* + *λευκόν* + deeply 'saturated' *μέλαν* is *κυανοῦν*. There seems no doubt that *κυανοῦν* is a deep blue of some kind (L. and S. s. v.). It is here regarded as something approaching to black, and the mention of *λαμπρόν* as a constituent suggests that it is highly lustrous. ? Indigo. One would be glad to know exactly how it differs from *ὄρφνινον*. Apparently by containing no red. If *ὄρφνινον* is a deep violet and *κυανοῦν* a deep blue, we can readily understand this.

68 c 6–7. κυανοῦ . . . γλαυκόν. *γλαυκόν* is a lighter shade of the same colour. As the epithet is common of the sea, of eyes, and of olives, one would suppose that what is meant is a blue varying at once to green and to grey. We learn from Aristotle (*de Generat. Animal.* E. 779^b 15 ff.), that Empedocles had a theory that eyes of this colour see badly by day because there is not enough water in them, while dark eyes see badly at night because there is not enough fire in them (*τὰ μὲν ἡμέρας οὐκ ὀξὺ*

βλέπειν, τὰ γλαυκά, δι' ἔνδειαν ὕδατος, θάτερα δὲ νύκτωρ δι' ἔνδειαν πυρός). I take it that E.'s thought is that, since 'like is perceived by like', an eye without enough water in it (water is *μέλαν ὕδωρ*) cannot see the shadows and dark tints by day; it only perceives a dazzling glare. At night the dark eye, which has not enough fire in it, for the like reason sees only an all-surrounding gloom and cannot take in the lighter lines and patches. As T. makes black a constituent of *γλαυκόν*, he presumably does not accept this particular Empedoclean theory. Aristotle admits the alleged fact, though he accounts for it differently. (According to Mr. Platt's note on the passage in the *de G. A.*, recent experiments show that Empedocles was mistaken about the fact.)

68 c 7. πυρροῦ δὲ μέλανι πράσιον. This is the most puzzling of all T.'s statements. *πράσιον* is shown by its name to be a vivid green, the colour of the *πράσον*. Why it should be supposed to be produced by a combination of a kind of red with black is a mystery. But it is only fair to remember that T. goes on to speak more emphatically than ever of the merely conjectural character of his colour-equations. One cannot help suspecting that speculations of this kind were common among some of his associates, and that they were put forth with a confidence which Plato, speaking through his mouth, thinks it proper to reprehend. If we knew more, we might perhaps even find that there is just a touch of burlesque underlying the whole passage. It is significant that Democritus, too, who had been deeply influenced by Pythagorean science, indulged in the same kind of speculation, and his very curious statements are recorded for us by Theophrastus in *de Sensu* 73–8 (*Doxogr. Graec.* 520–2).

Timaeus seems to me in the main to be trying simply to indicate resemblances of colour-sensations themselves by his equations, not to be talking of the results of either mixing pigments or superimposing lights. But his statement about *πράσιον*, if it is wholly serious, seems inexplicable.

68 d 4–7. θεὸς μὲν . . . ἔσται. Cf. for the spirit of the remark the words of Socrates *Phaedr.* 266 b 3 ff. We may remember the very similar view of Leibniz that to God all truths are *a priori* because God is capable of completing an infinite analysis and therefore sees the necessary connexion between the subject and predicate of every true proposition, whereas 'truths of fact' appear contingent to us because an infinite analysis is needed to exhibit their necessity. (Leibniz *Opuscules*, ed. Couturat 388 'propositio vera contingens non potest reduci ad identicas, probatur tamen, ostendendo continuata magis magisque resolutione, accedi quidem perpetuo ad identicas, nunquam tamen ad eas perveniri. Vnde solius Dei est, qui totum infinitum mente complectitur, nosse certitudinem ⟨omnium⟩ contingentium veritatum'.)

More important than the identification of the particular colours named by Timaeus is the relation of the whole theory to early speculations about colour-vision. The general doctrine of seeing by the fire in the eye goes back beyond Empedocles to Alcmaeon, of whom Theophrastus tells us (*de Sensu* 26, *Doxogr. Graec.* 506–7) that he said *ὀφθαλμοὺς* (? *ὀφθαλμοῖς*) *δὲ ὁρᾶν διὰ τοῦ πέριξ ὕδατος· ὅτι δ' ἔχει πῦρ δῆλον εἶναι, πληγέντος γὰρ ἐκλάμπειν. ὁρᾶν δὲ τῷ στίλβοντι καὶ τῷ διαφανεῖ, ὅταν ἀντιφαίνῃ, καὶ ὅσῳ ἂν*

καθαρώτερον ᾖ μᾶλλον. 'Our eyes see through the water round about. And it is manifest that the eye has fire in it, for when it is struck, the fire flashes out.' Stratton takes the 'water round about' to mean the 'humours' which enclose the supposed fire in the eye. Since Alcmaeon may be presumed to have regarded these, as Empedocles did, as ὕδωρ, this would be perfectly possible. But since the language suggests that the ὕδωρ is not merely 'round' the fire but round the whole structure of the eye, I should be inclined rather to suppose that it means what we still call the surrounding 'atmosphere'. Beare (*Greek Theories* p. 11) is, to judge from his translation, of the same opinion as to the meaning of this particular clause. If this is what is meant, it will follow that, as we should expect from the connexion of Alcmaeon with the early Pythagoreans and of early Pythagoreanism with Anaximenes, Alcmaeon looked on air, mist, water as all forms of the same thing. There is more uncertainty, to my mind, about the meaning of the second clause, which I would render literally, 'and we see with the gleaming, i. e. the diaphanous, when it shines back, and the purer it (i. e. τὸ στίλβον) is, the better we see'. That is, I take καὶ τῷ διαφανεῖ to be probably an addition of Theophrastus himself intended to explain a statement of Alcmaeon that we see by means of τὸ στίλβον. Hence I think Beare is right in refusing to suppose that the διαφανές and the στίλβον represent different parts of the eye, though he is not responsible for the explanation I have proposed for the double epithet. But what is the στίλβον? It seems to me that it means simply the fire in the eye itself. Beare thinks that it means the various membranes which enclose the visual ray, and that they, being diaphanous, serve as a mirror on which the visual ray, returning from its excursion, throws the image of the object it has met with. The evidence for ascribing a theory of this kind to Alcmaeon does not seem to me strong. Beare appeals to the Hippocratean work περὶ σαρκῶν (or ἀρχῶν) which speaks of the transparent membranes of the eye as reflecting the objects we see, and argues that as the tract also dwells on the anatomical connexion of eye and brain, it may have preserved Alcmaeon's theory of vision (op. cit. p. 12). This seems to me hardly justifiable, when we consider the eclectic character of a work which begins by laying it down that 'fire' is 'immortal' and 'omniscient'—the doctrine of Heraclitus—and then goes on at once to work in the four 'elements' of Empedocles, besides containing a good deal of Pythagorean lore about the biological significance of the number 7. And it should be noted that in the Hippocratean work nothing is said about any part played by 'fire' in the eye nor indeed about the presence of any 'fire' there. Vision is explained *wholly* by means of the reflection on the 'transparent' membranes (op. cit. Hippocr. i. 438 Kühn τουτέῳ γὰρ τῷ διαφανεῖ ἀνταυγέει τὸ φῶς καὶ τὰ λαμπρὰ πάντα. τουτέῳ οὖν ὁρῇ τῷ ἀνταυγέοντι). This looks like a theory of 'vision by the reflection in the eye' eclectically combined with Alcmaeon's views about the functions of the brain. I do not think it reasonable, as Beare does, to combine this passage of the περὶ σαρκῶν with the report in the *Placita* (iv. 14. 3, *Doxogr. Graec.* 405) of the Pythagorean theory of the reflection of the visual ray *from the surfaces of mirrors*, which we have already found Timaeus adopting, and to ascribe

the arbitrary combination to Alcmaeon. It seems to me unlikely that if Alcmaeon had really tried to combine the two radically incompatible theories of vision, Theophrastus would have made no comment on the inconsistency. Beare also argues that *στίλβειν* is not commonly said of the gleaming of a fire. Has he not forgotten that the stars *στίλβει* (twinkle), and that one of the planets was called *στίλβων* (the twinkler)? I think, then, that it is safest to suppose that Alcmaeon is still speaking of the 'fire' of the eye, and that the meaning is that we see when the fire in the eye 'shines back', i. e. meets the shining of the fire coming from the object seen. In that case his theory will be in principle the same as that of Empedocles and Timaeus. But see the elaborate discussion in Beare op. cit. 11–13. We have already dealt with the statements of Empedocles about vision in general, and need only add some remarks on his theory of colours. Plato himself says in the *Meno* (76 c–d) that E. accounted for colour-vision by 'effluences' from bodies, which fit into the 'passages' in the eye. The effluences are, in fact, necessitated by his general theory of perception, since the reason why 'like is known by like' is just the *συμμετρία* between effluences and *πόροι*. This point is duly recognized by Timaeus (67 c 7 *ὄψει σύμμετρα μόρια ἔχουσαν πρὸς αἴσθησιν*). Theophrastus tells us (*de Sensu* 7–8, *Doxogr. Graec.* 500–1) that according to E. we see white things by the 'pores' of the fire in the eye, black things by those of the water, because in both cases the effluences fit the respective *πόροι*. For the same reason animals which have a great preponderance of fire over water in their eyes see better by night, and those with a great preponderance of water over fire better by day (because in their case the excess of water is temporarily balanced by an addition of light from the sun). At § 17 (*Doxogr. Graec.* 504) he raises an obvious difficulty about the whole theory. The particles of effluences which are neither white nor black will fit neither the *πόροι* of the fire nor those of the water. Then how, on E.'s theory, do we ever come to see any of these colours? Probably it is to meet this very difficulty that T. modifies the theory. He keeps the 'effluences' and the 'fitting in' of them to *πόροι* in the visual stream, but he drops the view that 'black' is that which fits into the passages of the 'water' in the eye. He makes it that which does not fit into any of the passages but constricts them laterally, and he also accounts for our seeing such a variety of colours by allowing different sizes of particles of fire and different velocities of propagation. The passages in the 'water' of the eye now only come in to account for the watering of the eyes before a dazzling light. Thus A.-H. would have been right if he had simply said that there is a point of difference between E.'s theory and 'Plato's'. But he is wrong in saying that there are no 'effluxes' in the second. The *φλὸξ τῶν σωμάτων ἑκάστων ἀπορρέουσα* of Timaeus is just the *ἀπόρροια* of the Empedoclean theory. A.-H. goes on to confuse the 'effluences' of E., particles thrown off from the surfaces of things, with the *εἴδωλα* of Democritus, 'imprints' or 'casts' of bodies on the surrounding air or water, supposed to travel through the surrounding air or water until they reach the 'passages' of the sensory system. It is not much of an 'anachronism' to say that D.'s view is that a body is a centre of undula-

tions which are propagated until they affect our sense-organs. This is quite different from the Empedoclean theory, adopted by Timaeus, of the emission of actual particles from the body itself. A.-H. was perhaps misled by the fact that Epicurus modified the Democritean doctrine in an Empedoclean sense, substituting skins or coats of atoms actually detached from the surfaces of bodies for the *τύποι* or 'casts' of which D. had spoken. For D.'s view on this important point the comments of Theophrastus (*de Sensu* 49–50, *Doxogr. Graec.* 513) seem decisive. Thus D. explained that the 'reflection in the pupil' of the eye is formed thus, *τὸν ἀέρα τὸν μεταξὺ τῆς ὄψεως καὶ τοῦ ὁρωμένου τυποῦσθαι συστελλόμενον ὑπὸ τοῦ ὁρωμένου καὶ τοῦ ὁρῶντος· ἅπαντος γὰρ ἀεὶ γίνεσθαί τινα ἀπορροήν.* According to *de Sensu* 51, D. likened the formation of the 'imprint in the air' to the taking of a mould in wax (*ὥσπερ καὶ αὐτὸς λέγει παραβάλλων τοιαύτην εἶναι τὴν ἐντύπωσιν οἷον εἰ ἐκμάξειας εἰς κηρόν*). Th. notes that there is a redundancy in the theory. If there is an actual *ἀπορροή* from the object itself, what is the need for the *ἀποτύπωσις ἐν ἀέρι?* (ib. *ὅλως δὲ ἀπορροὴν ποιοῦντα τῆς μορφῆς . . . τί δεῖ τὴν ἀποτύπωσιν ποιεῖν; αὐτὰ γὰρ ἐμφαίνεται τὰ εἴδωλα*). On the other hand, if it is this *ἀποτύπωσις* we see, the 'image in the pupil' ought to be turned the wrong way on (ib. 52 *εἰ δὲ δὴ τοῦτο συμβαίνει καὶ ὁ ἀὴρ ἀπομάττεται καθάπερ κηρὸς ὠθούμενος καὶ πυκνούμενος, πῶς καὶ ποία τις ἡ ἔμφασις γίνεται; δῆλον γὰρ ὡς ἀντιπρόσωπος κτλ.*).

The views of the other Pre-Socratics who are known to us from Theophrastus as having theorized about colour-vision are of no special account for the *Timaeus*. Anaxagoras, who held that all perception is of 'unlike by unlike', took the rather childish line of explaining vision simply by a reflection cast on the pupil of the eye. This is to convert the eye into a looking-glass which is at the same time conscious of its contents. In fact, Anaxagoras actually supposes that the reflection of *A*'s face which *A* can see in *B*'s 'pupil' is either actually what *B* actually 'sees' when he looks at *A* or at any rate the immediate agent in his seeing of *A* (Theophrastus *de Sensu* 27, *Doxogr. Graec.* 507 *ὁρᾶν μὲν γὰρ τῇ ἐμφάσει τῆς κόρης, οὐκ ἐμφαίνεσθαι δὲ εἰς τὸ ὁμόχρων*; ib. 36–7, *Doxogr. Graec.* 509 for criticism of this type of view. Cf. also [Plato] *Alcibiades I.* 133 a for a moralizing application of the theory. Since the whole comparison of the good with the sun, the eye with the soul, and the world of colours with 'things seen' in the *Republic* presupposes the Empedoclean theory, which Socrates also propounds in the *Meno*, I should regard the assumption of the Anaxagorean view in the *Alcibiades* as one of the many indications that the dialogue is not Plato's but more probably the work of some contemporary of Aristotle.) Diogenes of Apollonia worked the Anaxagorean view into his own theory that objects cast a reflection on the pupil, and this 'mingling with the air in the brain' gives rise to sensation (Theophrastus *de Sensu* 40, *Doxogr. Graec.* 510 *τὴν δὲ ὄψιν* [*ὁρᾶν*] *ἐμφαινομένων εἰς τὴν κόρην, ταύτην δὲ μειγνυμένην τῷ ἐντὸς ἀέρι ποιεῖν αἴσθησιν*). The views of Democritus on the whole subject are recorded at great length by Theophrastus (op. cit. 50–4, *Doxogr. Graec.* 513–15, and for the theory of colour in particular 73–82, *Doxogr. Graec.* 520–4), but have no direct bearing on the *Timaeus*. He explained vision in

general by the entrance of the 'moulds', of which we have spoken, into the 'passages' of the eye. As for colours, he held that there are four 'primaries', white, black, red, green (*χλωρόν*), and that the physical cause of colour is, in the case of the first three, the size and shape of the atoms of the coloured body, in the fourth, the presence of considerable intervals of *κενόν* between the atoms. Theophrastus reports a long series of his statements about the way in which all other colours are 'blended' from the primaries, but it is not clear in what way he reached his conclusions. There is not sufficient coincidence with the equations of Timaeus to suggest that Plato used or knew the views of Democritus. Since we know from Aristotle that attempts were made to find 'numbers', i.e. numerical formulae, to explain such blends (see Aristot. *de Sensu* 439^{b} 25 ff., referred to *infra*), it is presumable that the origin of the whole speculation is Pythagorean. The success of Pythagoras in finding numerical laws for the relations of the notes of the octave would at once suggest that the same thing may be done in the sphere of vision, colours being regarded as a scale stretching from white to black and having its own fundamental intervals just as the musical scale has its *διὰ πασῶν*, *διὰ πέντε*, and *διὰ τεττάρων*. The common connexion with Pythagoras will sufficiently account for such general resemblances as there are between Timaeus and Democritus.

Aristotle's general theory of vision is given in the *de Anima* B and the *de Sensu*. In the *de Anima* the discussion of *ὄψις* and *τὸ ὁρατόν* is to be found at B. 418^{a} 26—419^{b} 3. The strict and proper object of vision is *χρῶμα*, colour, *plus* something which Aristotle says has no name in Greek (*ὃ λόγῳ μὲν ἔστιν εἰπεῖν, ἀνώνυμον δὲ τυγχάνει ὄν*, 418^{a} 27). In English it has a name, 'phosphorescence', which, unlike colour, can be seen only in the dark. Colour (*χρῶμα*) is 'that which effects a modification of the actually transparent' (*κινητικὸν τοῦ κατ' ἐνέργειαν διαφανοῦς*, 418^{a} 31), in fact, as we should say, a 'modification of illumination'. We cannot see colours in the dark because the 'actually transparent' is not visible *per se* but only as modified, as this or that colour. This is true of all transparent things, air, water, glass, and the like. They are not transparent *per se* but in virtue of a *φύσις* or characteristic which they share in common with one another and with the 'eternal body on high', i.e. the substance of the 'spheres' (*οὐ γὰρ ᾗ ὕδωρ οὐδ' ᾗ ἀήρ, διαφανές, ἀλλ' ὅτι ἐστὶ φύσις ἐνυπάρχουσα ἡ αὐτὴ ἐν τούτοις ἀμφοτέροις καὶ ἐν τῷ ἀιδίῳ τῷ ἄνω σώματι*, 418^{b} 7). The 'actuality' or 'active presence' (*ἐνέργεια*) of this characteristic is light (*φῶς*). Aristotle therefore defines light as the 'activity of the transparent as such' (*ἐνέργεια τοῦ διαφανοῦς ᾗ διαφανές*), and holds, as against views like those of Alcmaeon, Empedocles, Timaeus, that light is not a flame, an 'effluence' from any body, nor a body of any kind (*οὔτε πῦρ οὔθ' ὅλως σῶμα οὐδ' ἀπορροὴ σώματος οὐδενός*, 418^{b} 14). It is 'the presence of fire or something similar in the transparent' (*πυρὸς ἢ τοιούτου τινὸς παρουσία ἐν τῷ διαφανεῖ*, 418^{b} 16). Darkness is the absence of this 'condition' (*ἕξις*) from the transparent, and A. rejects the brilliant divination of Empedocles that light is transmitted locally and requires time for its transmission. The transparent is in its own nature colourless, and this is why by suitable modification all colours arise in it. Colour, then, is what is

seen in the light (what 'sets up a modification in the actually transparent', *τὸ μὲν ἐν φωτὶ ὁρώμενον χρῶμα . . . τοῦτο γὰρ ἦν αὐτῷ τὸ χρώματι εἶναι, τὸ κινητικῷ εἶναι τοῦ κατ' ἐνέργειαν διαφανοῦς*, 419ª 8–11). This is why we cannot see the colour of a thing in actual contact with the eye. There must be an interval occupied by a transparent medium, such as air or water, to be agitated by the colour and in its turn to agitate the eye (*ἐὰν γάρ τις θῇ τὸ ἔχον χρῶμα ἐπ' αὐτὴν τὴν ὄψιν, οὐκ ὄψεται· ἀλλὰ τὸ μὲν χρῶμα κινεῖ τὸ διαφανές, οἷον τὸν ἀέρα, ὑπὸ τούτου δὲ συνεχοῦς ὄντος κινεῖται τὸ αἰσθητήριον*, 419ª 12). Hence Aristotle held, against Democritus, that it would be impossible to see across a vacuum.

The same doctrine is also given in *de Sensu* 439ª 6—440ᵇ 25, with much more detail about colour. The colour of a visible object is the 'surface' or 'boundary' of the 'transparent' in it (*ἡ μὲν οὖν τοῦ φωτὸς φύσις ἐν ἀορίστῳ τῷ διαφανεῖ ἐστίν· τοῦ δ' ἐν τοῖς σώμασι διαφανοῦς τὸ ἔσχατον ὅτι μὲν εἴη ἄν τι, δῆλον, ὅτι δὲ τοῦτ' ἐστὶ τὸ χρῶμα ἐκ τῶν συμβαινόντων φανερόν*, 439ª 26), and this is indicated by language. For the Pythagoreans (whose dialect was Ionic) used the word *χροιή* (Attic *χρόα*) in the sense of 'surface', whereas in Attic it means 'colour' only (*διὸ καὶ οἱ Π. τὴν ἐπιφάνειαν χροιὰν ἐκάλουν*). A. holds that some degree of 'transparency' is found in all bodies, and this is the 'substrate' of their colour. They are coloured all through, but we only see the colour at its boundary (*τὴν αὐτὴν φύσιν δεῖ νομίζειν, ἥπερ καὶ ἔξω χρωματίζεται, ταύτην καὶ ἐντός*). Thus we get the definition that *χρῶμα* is *τὸ τοῦ διαφανοῦς ἐν σώματι ὡρισμένῳ πέρας*, 'the colour is the boundary of the transparent in a finite body' (439ᵇ 11). Colours form a linear series, with white which is analogous to light, at one end, and black, analogous to darkness, at the other (*ὥσπερ οὖν ἐκεῖ τὸ μὲν φῶς τὸ δὲ σκότος, οὕτως ἐν τοῖς σώμασιν ἐγγίγνεται τὸ λευκὸν καὶ τὸ μέλαν*, 439ᵇ 16). As for the other colours, A. suggests two ways in which we might think of them as derived from this fundamental pair. We might think of coloured surfaces as really made up by juxtaposition of black and white bits, too small to be seen singly (*ἐνδέχεται μὲν γὰρ παρ' ἄλληλα τιθέμενα τὸ λευκὸν καὶ τὸ μέλαν, ὥσθ' ἑκάτερον μὲν εἶναι ἀόρατον διὰ σμικρότητα, τὸ δ' ἐξ ἀμφοῖν ὁρατόν, οὕτω γίγνεσθαι*, 439ᵇ 19). Then we might hold that the seen colour of the whole depends on the numerical ratio of white to black bits (*ἔστι μὲν οὖν οὕτως ὑπολαβεῖν πλείους εἶναι χρόας παρὰ τὸ λευκὸν καὶ τὸ μέλαν, πολλὰς δὲ τῷ λόγῳ*, 439ᵇ 25). In some cases there may be no definite *λόγος* or ratio at all, i.e. the resulting colour would be analogous to a mere noise; in others there would be a strict numerical law like those of melodic progressions, and presumably the colours which we find most pleasing, such as *ἀλουργόν* or *φοινικοῦν*, are just those whose formula is simplest, as is the case with musical intervals (*τὰ μὲν γὰρ ἐν ἀριθμοῖς εὐλογίστοις χρώματα . . . τὰ ἥδιστα τῶν χρωμάτων εἶναι δοκοῦντα, οἷον τὸ ἀλουργὸν καὶ φοινικοῦν καὶ ὀλίγ' ἄττα τοιαῦτα, . . . τὰ δὲ μὴ ἐν ἀριθμοῖς, τἆλλα χρώματα*, 439ᵇ 31). Or we might account for colours by supposing an object to be seen through several layers of light and darkness (A. illustrates by the methods employed by painters to reproduce the effect of a colour seen through mist or water), and here again we may bring in the idea of dependence on arithmetical formulae, taking the numbers in the formula to express the

relation of the surface layer to those underneath it (λόγος γὰρ ἂν εἴη τις τῶν ἐπιπολῆς πρὸς τὰ ἐν βάθει, τὰ δὲ καὶ ὅλως οὐκ ἐν λόγῳ, 440ᵃ 13). One may feel pretty sure that all this is based on real attempts by those whom A. calls the ἀρχαῖοι, 'ancients', to work out a mathematical theory of colours analogous to mathematical 'harmonics', and there cannot be much serious doubt from what quarter these attempts came. Ar. does not fully approve of the doctrine in either form. Partly he thinks that in most cases you would find that there is no simple λόγος of integer to integer. ('Surd' expressions might be expected to turn up on either version of the theory.) Also, both forms of the theory seem to him to suggest that colours are 'effluences' which require time for their transmission to the observer's eye (see 440ᵃ 15 ff.). Also he prefers to think that continuous bodies, being divisible *ad indefinitum*, combine not by juxtaposition of indivisible bits, but by μεῖξις δι' ὅλων, complete integral 'interpenetration' or 'fusion' (440ᵃ 31 ff.). This entails the view that there is also 'interpenetration' or 'fusion', not juxtaposition, of their colours. Still, he adds, this is not inconsistent with the belief that some colours at least represent definite numerical 'blends' of black and white, since things may 'fuse' according to a law of ratio (πολλαὶ δ' ἔσονται χρόαι διὰ τὸ πολλοῖς λόγοις ἐνδέχεσθαι μείγνυσθαι ἀλλήλοις τὰ μειγνύμενα, καὶ τὰ μὲν ἐν ἀριθμοῖς τὰ δὲ καθ' ὑπεροχὴν μόνον, 440ᵇ 18). The Peripatetic tract *de Coloribus*, included in the Aristotelian *Corpus*, is pretty certainly not Aristotle's and contains nothing much to our purpose. It begins by the assertion that there are two primary colours, λευκόν and ξανθόν; λευκόν is the natural colour of earth, air, water, ξανθόν of fire and sunlight. We have also to reckon as a third primary μέλαν, the colour assumed by every 'element' in the process of transmutation into another. All other colours are blends of two or of three of these primaries, but no attempt is made to show in detail what the formulae for the different blends are. The most interesting thing in the essay is the remark that we should not base our theories on the way in which pigments are mixed but on the observed effects of different illuminations on the colour of the same object (op. cit. 792ᵇ 16). This remark shows a true insight into the right method of studying the facts of colour-vision, but most of the work is taken up with purely irrelevant observations about the way in which vegetation changes its colour as it ripens, and the relation of the colouring of the hair and feathers to the general physiology of the animal organism.

68 e 1—69 a 5. ταῦτα δὴ πάντα . . . μετασχεῖν. A brief recapitulation of what has been said before at 48 a 1 ff. about the distinction between God, the true 'cause' of the οὐρανός, and ἀνάγκη, which is only an 'understrapper'. I suggest, as before, that ἀνάγκη stands as a collective name for the sum-total of the 'conjunctions' or 'collocations' which we have to accept as so much ultimate and unexplained bare fact—as conjunctions, to use Hume's phrase, in which we can see no 'connexion'—because *we* cannot see what they are good *for*. Timaeus thus recognizes that faith has its legitimate place in our view of the world no less than demonstration. There is no suggestion of any ultimate 'dualism' between God and the 'subsidiary' causes. It is not suggested that the 'subsidiary' cause is in any way refractory or rebellious against the purposes to which it is put by

God. It is true the οὐρανός cannot be made 'perfect', but that is simply because it is a γιγνόμενον, not from any 'radical evil' in the ingredients of this particular γιγνόμενον.

68 e 7. καὶ τὸ μὲν θεῖον κτλ. That is, the real function of religious faith is practical. We should try to discern God's hand in nature, 'so far as our constitution permits' for the sake of 'attaining the happy life', i.e. to make us what we ought to be, to lead to the 'salvation of our souls', not as a mere gratification for speculative curiosity. We study natural science (τὸ ἀναγκαῖον) as an aid to this, because we cannot discern God's way of dealing with His creatures except by loving and minute study of the whole system of nature. But the *ultimate* end of this study of natural science, too, is not the mere gratification of curiosity, but 'growth in grace'. The ἐφ' οἷς σπουδάζομεν of 69 a 3 is a reminder that, according to the Pythagorean view our real business on earth is just 'making our souls', living well. As we know from the *Phaedo*, the Pythagorean view was that the importance of the 'sciences' (μαθήματα) is precisely that they are a way of 'purgation'; they 'detach from the flesh', that is, from absorption with the petty personal concerns of our temporary 'prison-house', and so prepare us for our real destiny of 'deification' (ὁμοίωσις θεῷ). The μαθήματα of which the Pythagoreans held this view were primarily the mathematical disciplines which they had created, but Timaeus means here to claim the same function for the less 'exact' studies of biology and natural history. Plato himself nowhere shows any sign of accepting the doctrine ascribed to the γνησίως φιλόσοφοι in the *Phaedo*, that the business of life is simply to learn how to die (μελετᾶν ἀποθνήσκειν), but he fully accepts the view that it is our business to make the personal comfort of the body, and the small temporal ambitions very secondary things, and, as the *Laws* puts it, to reverence the ψυχή next to the gods and the body only in a subordinate degree (*Laws* v. 726, 6 οὕτω δὴ τὴν αὑτοῦ ψυχὴν μετὰ θεοὺς ὄντας δεσπότας καὶ τοὺς τούτοις ἑπομένους—sc. the great dead, our parents, &c.—τιμᾶν δεῖν λέγων δευτέραν, ὀρθῶς παρακελεύομαι). The suggestion of σπουδάζομεν is that physics and biology are after all the παιδιά, the 'recreation' or 'play', not the 'work' of a thoughtful man. Plato says the same thing even of the study of laws and political institutions (*Laws* iii. 685 a 6 περὶ νόμων παίζοντας παιδιὰν πρεσβυτικὴν σώφρονα, vi. 769 a 1 καλῶς τοίνυν ἂν ἡμῖν ἡ πρεσβυτῶν ἔμφρων παιδιὰ μέχρι δεῦρ' εἴη τὰ νῦν διαπεπαισμένη). To live aright and to direct a community in living aright is σπουδή, 'work'; the 'moral sciences', the mere speculative discussion of the way in which a man or a πόλις lives aright, is at best παιδιά, 'play'.

The recapitulation is inserted at this point because T. is now passing to a new division of his subject. He has finished what he had to say about the sensible qualities of bodies in general, and is going on to speak of the modifications made necessary for the ψυχή itself by its connexion with a body, and of the anatomy and physiology of that body itself. Physics now ceases to be the immediate background of his discourse, and its place is taken by biology and medicine. He now comes to treat of the θνητόν, the *mortal* in us, the making of which had been assigned to the inferior 'created gods'.

69 a 6—73 a 8. ὅτ' οὖν δὴ . . . τῶν παρ' ἡμῖν. The creation of the mortal 'elements' in the *ψυχή* and of the bodily organs which are their immediate seat. We begin with a few more words of recapitulation intended to take us back in imagination to the scene described at 42 e, where the 'created gods' have been assigned their work and their 'raw material', and are about to enter on their task.

69 a 6. οἷα τέκτοσιν ἡμῖν ὕλη. The *ὕλη* we have before us is the two kinds of cause, the primary, God, and the subsidiary, *ἀνάγκη*. They have been carefully discriminated, and we are thus in the position of workmen who have the different materials out of which they are about to construct something properly 'sorted', and only require to combine them in the right way. But to what kind of workmen in particular is T. comparing himself and his auditors? A *τέκτων* is primarily a carpenter or worker in wood, though the word is constantly used in a wider sense of artificers in many other sorts of material (see the Lexicon s. v.). The mention of *ὕλη* shows that T. is thinking of the original sense of the word. The image is that of a worker in wood who has before him the different kinds of wood or timber he will need for the different parts of that which he is going to construct, e. g. a man who is going to build a house or a ship. At *συνυφανθῆναι* (69 a 8) we pass to the image of a weaver with assorted threads of different material or strength before him. This is not so much a 'mixture' of metaphors as a rapid succession of alternative pictures of the same process, like the so-called 'mixed metaphors' of Shakespeare's style at its ripest. We must not suppose that *ὕλη* means 'matter' in the Aristotelian sense; it definitely means 'wood' or 'timber', the raw material of the *τέκτων*, and the word could not be used here except in combination with some expression which would give it that precise reference. In Plato there is no instance of the employment of the word to mean the 'raw material' of *any* process of construction or development, unless we admit a single example, *Philebus* 54 c 1 *φημὶ δὴ γενέσεως μὲν ἕνεκα φάρμακά τε καὶ πάντα ὄργανα καὶ πᾶσαν ὕλην παρατίθεσθαι πᾶσιν*, where it would be possible to take *ὕλην* to mean 'raw material' in general. But even here it does not seem certain that the sense is not 'timber', and that the meaning is not simply that '*φάρμακα*, tools, timber' are three examples of things which are valuable because they subserve the *γένεσις* of something. This interpretation seems to me confirmed by the fact that in 54 b immediately above, *ναυπηγία*, the construction of ships, has just been given as an example of a *γένεσις*. Hence I think that the three things subsequently enumerated are meant to be things employed by the *ναυπηγός*, his *paints*, his tools, his planks. (For *φάρμακον* in the sense of a paint see the examples in L. and S. *φάρμακον* III, and note that one of them is Platonic, *Politicus* 277 c 2 *τοῖς φαρμάκοις καὶ τῇ συγκράσει τῶν χρωμάτων*.) Since the commonest meanings of *ὕλη* are (*a*) forest, (*b*) firewood, (*c*) ship's timbers, it is tempting to suppose that Timaeus is thinking particularly of the *naval* carpenter. Since, however, he is usually called in Greek by the special name *ναυπηγός*, it is perhaps safer to leave it undecided whether the *τέκτονες* meant are builders of ships or builders of houses.

69 a 7. διυλισμένα. This is the reading of A^3 and, as we now know

of F, against the *διυλασμένα* of W Y. (The *διυφισμένα* of A, as far as can be seen, means nothing at all.) *διυλισμένα* is thus the best accredited reading, and we should not follow Bekker, St., Martin, the Zürich editors, and A.-H. in adopting the text of Y. The word means 'filtered', 'strained pure'.[1] A.-H. objects that it is a 'late' word, but it would be rash to assume that it did not exist in the fourth century, merely because it does not happen to occur elsewhere in our scanty remains of fourth-century literature, where the common word for 'filtered' is *διηθημένος*. W Y's *διυλασμένα* is supposed by those who adopt it to mean 'sorted out', as a carpenter or shipwright might sort out the different kinds or shapes of wood which he meant to employ, but apparently the word is not even 'late', but does not occur anywhere else. I suppose those who accept it do so to avoid a 'mixed' metaphor, but since we have in any case the *τέκτων* and the *ὑφάντης* in the picture already, this is ill-timed purism.

69 b 1. κεφαλήν. Plato speaks more than once of 'putting the *κεφαλή* on' a *μῦθος*, or of a *λόγος* as something which has a *κεφαλή*. Cf. *Gorgias* 505 c 10 *ἀλλ' οὐδὲ τοὺς μύθους φασὶ μεταξὺ θέμις εἶναι καταλείπειν, ἀλλ' ἐπιθέντας κεφαλήν, ἵνα μὴ ἄνευ κεφαλῆς περιίῃ*, *Phaedrus* 264 c 2 *δεῖν πάντα λόγον ὥσπερ ζῷον συνεστάναι σῶμά τι ἔχοντα αὐτὸν αὑτοῦ, ὥστε μήτε ἀκέφαλον εἶναι μήτε ἄπουν, ἀλλὰ μέσα τε ἔχειν καὶ ἄκρα, πρέποντα ἀλλήλοις καὶ τῷ ὅλῳ γεγραμμένα*, *Philebus* 66 d 1 *οὐδὲν λοιπὸν πλὴν ὥσπερ κεφαλὴν ἀποδοῦναι τοῖς εἰρημένοις*. Two metaphors perhaps cross in these passages. The *λόγος* is compared with a painting of an animal, as particularly in the *Phaedrus* passage. In the passage from the *Gorgias* this seems to be the underlying idea, to which it is added by a touch of burlesque that it would never do to let the creature run off before its head was on. But the *ἐπιθεῖναι* suggests also the notion of putting the *κεφαλή* or 'capital' on a column; *ἀποδοῦναι*, as in the words from the *Philebus*, would perhaps be the more appropriate expression if the image of the painted *ζῷον* were the only one in view.

69 b 3. ἀτάκτως ἔχοντα. The words have to be taken as if governed by *συμμετρίας ἐνεποίησε*. The 'anacoluthon' is one of a simple and common type. Plato begins as though he meant to say *συνεκεράσατο* or *συνεστήσατο* and then substitutes the equivalent expression *συμμετρίας ἐνεποίησε*, so that the *ταῦτα ἀτάκτως ἔχοντα* has no formal regimen and is to all intents and purposes an 'absolute' accusative. The precise reference in the words *ὥσπερ . . . καὶ κατ' ἀρχὰς ἐλέχθη* is presumably to 30 a 4–5 (referred to by A.-H.), *παραλαβὼν οὐχ ἡσυχίαν ἄγον ἀλλὰ κινούμενον πλημμελῶς καὶ ἀτάκτως, εἰς τάξιν αὐτὸ ἤγαγεν ἐκ τῆς ἀταξίας*.

69 b 6. τούτων, grammatically *neuter*, but it means the *συμμετρίαι*. It is wrong to find, as some do, a polemical reference to Democritus in the words *ὅσον μὴ τύχῃ*. The charge is made against all the secularistic scientific men in *Laws* 889 a 4 ff. *ἔοικε, φασίν, τὰ μὲν μέγιστα αὐτῶν καὶ κάλλιστα ἀπεργάζεσθαι φύσιν καὶ τύχην, τὰ δὲ σμικρότερα τέχνην . . . πῦρ καὶ ὕδωρ καὶ γῆν καὶ ἀέρα φύσει πάντα εἶναι καὶ τύχῃ φασίν, τέχνῃ δὲ οὐδὲν τούτων*. The offender who is most prominent in Plato's mind here is

[1] Cf. Clement Alex. *Stromat.* ii. 116 (Stählin, pp. 175–6) *χρυσοῦ δ' ἀπὸ γῆς οὐκ αἴρεται βῶλος, ἀλλ' ἀφεψόμενος διυλίζεται, ἔπειτα καθαρὸς γενόμενος, χρυσὸς ἀκούει, γῆ κεκαθαρμένη.*

Empedocles; the Atomists, who held that πῦρ and the like are *not* ultimate φύσεις with distinctive 'qualities' are not the persons of whom he is specially thinking, though from the point of view of Plato or Timaeus the criticism would include them, since they, like the rest, assume only 'natural' causes in their cosmology. In Plato's language, to say that the order of the world is due to τύχη is the same thing as denying that it is due to intelligent design. The Atomists themselves denied that anything is due to τύχη; Leucippus 'Fr. 2' (*Fr. d. Vors.*[5] ii. 10) οὐδὲν χρῆμα μάτην γίνεται, ἀλλὰ πάντα ἐκ λόγου τε καὶ ὑπ' ἀνάγκης, Democritus Fr. 119 (*Fr. d. Vors.*[5] ii. 84) ἄνθρωποι τύχης εἴδωλον ἐπλάσαντο πρόφασιν ἰδίης ἀβουλίης. But as this only meant that nothing happens without *a* cause, it does not exempt them from Plato's censure. In the present place there is no polemical allusion. Even in a chaos it might happen here and there that a particle had approximately the shape of one of T.'s regular solids—indeed, if no particle had such a shape, one might fairly presume that there had been a deliberate exclusion of the regular shapes—and this is all that is meant. T. is perhaps thinking of the actual verses of Empedocles which describe the state of things when φιλία has made one conglomerate of all the 'roots' (Fr. 27, *Fr. d. Vors.*[5] i. 237 = R. P. 168) ἔνθ' οὔτ' Ἠελίοιο διείδεται ὠκέα γυῖα | οὐδὲ μὲν οὐδ' αἴης λάσιον μένος οὐδὲ θάλασσα, and again of Anaxagoras' πανσπερμία, the amalgam of all the seeds or molecules into which νοῦς has not as yet introduced the revolution which sets up an οὐρανός, Anax. Fr. 1 (= R. P. 151) ὁμοῦ πάντα χρήματα ἦν, ἄπειρα καὶ πλῆθος καὶ σμικρότητα· καὶ γὰρ τὸ σμικρὸν ἄπειρον ἦν. καὶ πάντων ὁμοῦ ἐόντων οὐδὲν ἔνδηλον ἦν ὑπὸ σμικρότητος· πάντα γὰρ ἀήρ τε καὶ αἰθὴρ κατεῖχεν, ἀμφότερα ἄπειρα ἐόντα. Anaximander's ἄπειρον would also be devoid of the 'opposite' characters which are sorted out (ἐκκρίνεται) by the 'eternal motion'.

69 c 1. διεκόσμησεν. If this contains any special allusion, it must be an echo of the famous words of Anaxagoras (Fr. 12 = R. P. 155) that νοῦς '*set in order* whatever was to be and whatever was, all that now is not and all that is' (καὶ ὁποῖα ἔμελλεν ἔσεσθαι καὶ ὁποῖα ἦν, ἄσσα νῦν μὴ ἔστι, καὶ ὁποῖα ἔστι, πάντα διεκόσμησε νοῦς). It seems more likely than not that T. means to recall the words.

69 c 3. καὶ τῶν μὲν θείων αὐτὸς γίγνεται δημιουργός. That is, God is the αὐτουργός of the 'divine' in us, the *anima rationalis*. Since the αὐτουργός, the 'peasant' who tills his piece of ground with his own hands, is always regarded as in a particularly lowly position (cf. *Rep.* viii. 565 a 1 δῆμος δ' ἂν εἴη τρίτον γένος, ὅσοι αὐτουργοί τε καὶ ἀπράγμονες, οὐ πάνυ πολλὰ κεκτημένοι, Xenoph. *Oecon.* v. 4 καὶ τοὺς μὲν αὐτουργοὺς διὰ τῶν χειρῶν γυμνάζουσα—sc. ἡ γῆ—ἰσχὺν αὐτοῖς προστίθησι, τοὺς δὲ τῇ ἐπιμελείᾳ γεωργοῦντας—the 'farmers' who can employ 'hands'—ἀνδρίζει κτλ., Thuc. i. 141 αὐτουργοί τε γάρ εἰσι Πελοποννήσιοι καὶ οὔτε ἰδίᾳ οὔτ' ἐν κοινῷ χρήματά ἐστιν αὐτοῖς κτλ.)—the words are worth noting. It is generally said that the thought of God as humbling Himself in the service of His creatures, indeed, as being accessible to them at all, except through the mediation of a whole hierarchy of officials, 'angels' and the like, is specifically Christain and not Hellenic, and there is truth in the remark if it is not pressed too far. Hence an expression like that used here

deserves to be noted as showing that its author understood the principle of the words 'I am among you as one that serveth'. It is only the subsidiary work which the Creator deputes to the minor gods; He executes the main task with His own hands.

69 c 7. ὄχημα, a 'chariot' or 'car' to ride on. Cf. the famous myth in the *Phaedrus*, also obviously of Pythagorean inspiration, where the soul is figured as a charioteer driving a car drawn by a pair of horses of different strain (*Phaedr.* 246 a 6 ἐοικέτω δὴ συμφύτῳ δυνάμει ὑποπτέρου ζεύγους τε καὶ ἡνιόχου, 253 c 7 τριχῇ διείλομεν ψυχὴν ἑκάστην, ἱππομόρφῳ μὲν δύο τινὲ εἴδη, ἡνιοχικὸν δὲ εἶδος τρίτον). There, however, our attention is demanded only for the charioteer and the horses, which represent the 'tripartite' soul, λογιστικόν, θυμός, ἐπιθυμία, and nothing is said of the 'car' itself. Here it is the body which is the 'car' of the 'immortal soul'. At 41 e 1 we had still a third use of the image, where the star allotted to each of the as yet unembodied souls was described as an ὄχημα on which it was mounted in order to take a perspective view of the whole οὐρανός in which it would be called on to play its part. It is from the *Phaedrus* and *Timaeus* that the Neo-Platonists derived their speculations about the permanent ὄχημα or vehicle of the soul, by which they meant a sort of 'spiritual' and imperishable body which attends the soul through all its wanderings and is inseparable from it. For the demonstration of the existence of these ὀχήματα see Proclus στοιχείωσις θεολογική 196 πᾶσα ψυχὴ μεθεκτὴ σώματι χρῆται πρώτως ἀιδίῳ καὶ ἀγέννητον ἔχοντι τὴν ὑπόστασιν καὶ ἄφθαρτον. The 'eternal' vehicle was supposed to receive successively grosser accretions as the ψυχή 'descends to generation' through the various heavens and to lay these accretions (which were identified with the Orphic χιτών) aside again as it reascends. (Proclus op. cit. 207–10, cf. especially 209 πάσης μερικῆς ψυχῆς τὸ ὄχημα κάτεισι μὲν προσθέσει χιτώνων ἐνυλοτέρων κτλ.) There was, however, no agreement in the school about the details of the doctrine.

ib. ἄλλο τε εἶδος . . . ψυχῆς. Thus we find Timaeus teaching precisely the 'tripartite' psychology of the *Republic*. The only differences are that each 'part' of the ψυχή is provided with a local habitation in the body and that it is expressly said that θυμός and ἐπιθυμία are 'mortal'. This had already been plainly intimated in *Republic* x. 611 b 9—612 a 6. The localization of the different εἴδη in different regions of the body is naturally not touched on in the *Republic*, where physiology and medicine are no part of the subject in hand, and the doctrine is only brought in for the sake of ethical and political applications. It is needless to suppose that the points which do not appear in the *Republic* are the product of a process of development in Plato's mind subsequent to the composition of that dialogue. A more natural view would be that the physiology is an integral part of the original doctrine, omitted in the *Republic* because it is irrelevant there, though a careful reading will reveal the presence of expressions which may be seen, in the light of the *Timaeus*, to presuppose the whole theory, or at least the connexion of the θυμοειδές with the στήθη and of the ἐπιθυμητικόν with the 'crib' (φάτνη) in the belly. Even from the *Republic* itself we might gather, from the readiness with which the doctrine is understood by the audience, that we are dealing with some-

thing already familiar to educated circles. This is made clearer by the way in which the *Gorgias* refers without any explanation to 'that part of the soul in which the appetites are' (493 b 1 *τοῦτο τῆς ψυχῆς οὗ αἱ ἐπιθυμίαι εἰσί*. Cf. *Phaedo* 83 b, where the influences from which the soul of the true *φιλόσοφος* seeks to free itself are spoken of as *ἡδοναί, ἐπιθυμίαι, λυπαί, φόβοι*, since *φόβος*, like its opposite *θάρρος*, is specifically a state of *θυμός*). The employment of the doctrine by Timaeus is in itself a good reason for supposing that it is originally Pythagorean and stands in intimate connexion with the famous apologue of the three kinds of life (*βίος φιλόσοφος, β. φιλότιμος, β. φιλοσώματος* or *φιλήδονος* or *φιλοχρήματος*, or, as Aristotle calls it, *ἀπολαυστικός*). This would explain why Socrates himself is not wholly satisfied with the theory in the *Republic*, as is proved by his adopting it at 435 d as a mere 'short cut', adequate enough for his immediate purpose of discriminating the leading types of moral excellence distinctive of the different great classes or callings in society, the statesman, the soldier, the civilian business man, but devoid of scientific exactness (*καὶ εὖ γ' ἴσθι, ὦ Γλαύκων, ὡς ἡ ἐμὴ δόξα, ἀκριβῶς μὲν τοῦτο ἐκ τοιούτων μεθόδων, οἵαις νῦν ἐν τοῖς λόγοις χρώμεθα, οὐ μή ποτε λάβωμεν . . . ἴσως μέντοι τῶν γε προειρημένων τε καὶ προεσκεμμένων ἀξίως*). We could hardly be told more expressly that the whole thing is merely 'popular', not 'scientific' psychology. There is also, as Bt. has reminded us, important external evidence to the same effect. Galen reports Posidonius as expressly asserting that the doctrine was Pythagorean. It is further confirmation of the pre-Socratic origin of the theory that Aristides Quintilianus has preserved the obviously ancient tradition that the *θυμοειδές* in the *ψυχή* constitutes an harmonic mean with the *λογιστικόν* and the *ἐπιθυμητικόν*.[1] This brings the 'tripartite soul' at once into direct connexion with the Pythagorean discoveries in music. This connexion is kept up in the *Republic* itself, where (443 d–e) the 'parts' in a 'righteous' soul are compared with the *νεάτη, μέση*, and *ὑπάτη* (443 d 5 *ὥσπερ ὅρους τρεῖς ἁρμονίας ἀτεχνῶς, νεάτης τε καὶ ὑπάτης καὶ μέσης κτλ.*). Thus the soul is looked on as primarily a rightly constructed 'octave'. The idea still survives in both Plutarch and Proclus. Plutarch (*Quaestiones Platonicae*

[1] *EGPh.*[3] 296, n. 2. Galen *de Hippocratis et Platonis placitis* (ed. I. Müller), iv, p. 401 (Kühn 425) *τὴν αἰτίαν ἐρωτᾷ κάνταῦθα ὁ Ποσειδώνιος δι' ἣν πολλοὶ μὴ βουλόμενοι πολλάκις κλαίουσιν ἐπισχεῖν μὴ δυνάμενοι τὰ δάκρυα, καὶ ἄλλοι κλαίειν ἔτι βουλόμενοι φθάνουσι παυομένοι· γίνεσθαι δέ φησι διὰ τὰς παθητικὰς κινήσεις . . . οὐ γὰρ Ἀριστοτέλης μόνον ἢ Πλάτων ἐδόξαζον οὕτως, ἀλλ' ἔτι πρόσθεν ἄλλοι τέ τινες καὶ ὁ Πυθαγόρας, ὡς καὶ ὁ Ποσειδώνιός φησιν, ἐκείνου πρώτου μὲν εἶναι λέγων τὸ δόγμα, Πλάτωνα δ' ἐξεργάσασθαι καὶ κατασκευάσαι τελεώτερον αὐτό.* Ib. v. 459 (Kühn 478) where Galen speaks of the theory *ἣν Ἱπποκράτης τε καὶ Πλάτων ἁπάντων πρῶτοι μετεχειρίσαντο*, and adds *Ποσειδώνιος δὲ καὶ Πυθαγόραν φησίν, αὐτοῦ μὲν τοῦ Πυθαγόρου συγγράμματος οὐδενὸς εἰς ἡμᾶς διασωζομένου, τεκμαιρόμενος δὲ ἐξ ὧν ἔνιοι τῶν μαθητῶν αὐτοῦ γεγράφασιν.* Posidonius on the *πάθη* is one of the principal works appealed to by Galen for the Platonic against the Stoic view of the soul; he frequently quotes it verbatim. He is thus taking his information about the statement of Posidonius at first-hand from a book with which he was intimately acquainted. It is clear also from the second of the passages quoted that Posidonius was not imposed on by forged writings purporting to be by Pythagoras. This makes his statement that he had found the doctrine of the *εἴδη ἐν τῇ ψυχῇ* in Pythagorean literature all the more important. Cf. Aristides Quintilianus iii, p. 128 (Meibom), *εὑρήσεις λογισμοῦ καὶ ἐπιθυμίας μέσην τὴν κατὰ τὸ θυμικὸν ἀμφοῖν ἀναλογίαν.*

1007 e) raises the question to which of the three notes each 'part' of the soul corresponds, and decides that *θυμός* and *ἐπιθυμία*, as opposites and extremes, answer respectively to *νήτη* and *ὑπάτη*, the *λογιστικόν* being a 'mean' between them, and so answering to the *μέση* of music. Proclus discusses the same point in the commentary on the *Republic* (Kroll i. 213) and takes the view that the whole interval *λογιστικόν—ἐπιθυμητικόν* answers to the *διὰ πασῶν*, and that its constituents, the intervals *λογιστικόν—θυμοειδές*, *θυμοειδές—ἐπιθυμία* answer respectively to the *διὰ πέντε* and *διὰ τεσσάρων* on the grounds that in this way the difference between *λόγος* and *ὄρεξις*, which is greater than that between two types of *ὄρεξις*, is made to correspond to the greater of the two intervals in the octave, and the 'consonance' of rightly tuned *λόγος* and *ὄρεξις* is thus also, as it should be, a completer and greater *συμφωνία* than that between two rightly tuned *ὀρέξεις*. Thus Proclus makes *λογιστικόν* correspond with *νήτη*, *ἐπιθυμητικόν* with *ὑπάτη*, *θυμοειδές* with *μέση*, and this is unmistakably what the *Republic* really means.

It is often said that the *Timaeus* differs from the *Republic* in assigning to each of us not merely three 'parts' in the soul, but three distinct souls, two of which are perishable. This is, however, not an accurate statement. Timaeus never says that the 'created gods' endowed men with a second and third soul, but merely that they 'built on' or 'added' the *θνητὸν εἶδος ψυχῆς* or *θνητὰ εἴδη ψυχῆς* to the original design. His metaphors are taken from the enlargement of a building by later additions, and tell against, not for, the conversion of the tripartite *ψυχή* into three *ψυχαί*. The use of the word *εἴδη* to denote the constituents of the incarnate *ψυχή* is about as frequent in the *Republic* itself as the employment of the words *μέρη*, *μόρια*. As to the *mortality* of the inferior *εἴδη*, we have seen that it is very plainly hinted at in the tenth book of the *Republic*. With the Neo-Platonists it became a disputed point whether *θυμός* and *ἐπιθυμία* survive the body or not, and if so whether they are strictly immortal. Iamblichus held that they survive, Plotinus, Porphyry, Proclus that they do not. Timaeus evidently holds the Plotinian view, and it is pretty plainly taken for granted throughout the *Phaedo* that the *καθαροί* who have got clear of the body are free from the *θυμοειδές* and *ἐπιθυμητικόν*. There cannot be much doubt that this was Plato's own conviction, since the *Philebus* makes it quite plain that, though for men as they now are the best kind of life is a 'mixed' one, including both 'thought' and 'pleasure', there is an absolutely best 'divine' life of 'thought' and 'intelligence' which is not 'mixed' at all (*Philebus* 22 c 3 *οὐδὲ γὰρ ὁ σὸς νοῦς, ὦ Σώκρατες, ἔστι τἀγαθόν, ἀλλ' ἕξει που ταὐτὰ ἐγκλήματα.—τάχ' ἄν, ὦ Φίληβε, ὅ γ' ἐμός· οὐ μέντοι τόν γε ἀληθινὸν ἅμα καὶ θεῖον οἶμαι νοῦν, ἀλλ' ἄλλως πως ἔχειν*). And we know that Plato's ideal for man is to become 'as like God' as possible. Hence we can hardly doubt that he means to regard assimilation to God in this respect as the supreme blessedness of man, though it is a blessedness not to be attained during our earthly pilgrimage. This does not mean that Plato regards the supremely blessed life as one of mere knowing unattended by any kind of feeling or doing. We must remember that *ἐπιθυμία*, for instance, with him does not usually cover the whole range of 'conation' or

'endeavour', but is specifically restricted to appetitions connected with the functions of the body. Hence, when he wishes to speak of conation or appetition and the feeling of successful appetition more generally, he is led to use language which looks like a contradiction, as for example at *Rep.* ix. 580 d 7, where we are told that each of the εἴδη of the ψυχή has its own ἐπιθυμίαι, in spite of the fact that one of the three εἴδη has been called the ἐπιθυμητικόν by way of distinction from the other two. We must not manufacture Platonic doctrine out of the mere linguistic fact that Plato has not yet found a name, like Aristotle's ὄρεξις, for 'endeavour' in general. The elimination of the merely 'mortal' from a ψυχή as described in the *Republic* would not reduce it to a thing without conation or feeling; it would only suppress its interest in supplying the primary organic appetites and the secondary 'artificial' wants derivative from them. Still less must we attribute to Plato the theory that the disappearance of the θνητόν in the ψυχή entails the loss of individual personality.

69 c 8–9. δεινὰ καὶ ἀναγκαῖα . . . ἔχον. ἀναγκαῖα means simply 'unavoidable', in the very common sense of ἀναγκαῖον = that which you would prefer to do without if you could. A.-H. gets this right in his *translation*, but his note, 'necessarily inherent in their own nature', gives a false sense. παθήματα, again, means only 'attributes' or 'effects'; to render it 'passions' is misleading owing to the associations of the word 'passion' in modern English.

69 d 1. ἡδονήν, . . . δέλεαρ. The genitive κάκου is 'subjective', 'pleasure, sin's most potent lure'. ἡδονή, i. e. the expectation of it, is thought of as the 'bait' with which τὸ κακόν fishes for souls. It is Timaeus who is speaking, but Plato would agree with him that more moral mischief is wrought by lust after pleasure than by fear of pain. In *Laws* i. 633 c, 635 a, the Spartans are said to teach only one ἀρετή, and only the less important half of that, because their famous training steeled men to face pain and danger but certainly failed to teach them to resist the allurements of pleasure. In both *Republic* and *Laws* steadfastness in resisting these allurements is regarded as an indispensable part of ἀνδρεία, and in the *Laws* it is expressly said to be the more important part.

69 d 2. λύπας, ἀγαθῶν φυγάς. The genitive is one of separation, the sense being 'pains that scare us from good things'. Pain makes a man flinch from the good he might have secured by enduring the pain, as e.g. when he refuses to regain health by submitting to a painful operation or a disagreeable regimen.

ib. **θάρρος καὶ φόβον.** The Academic definition of φόβος, based on the *Laches*, was ἔκπληξις ψυχῆς ἐπὶ κακοῦ προσδοκίᾳ, 'distress of mind due to anticipation of impending evil' ([Plat.] ὅροι, 415 e). θαρρεῖν in Greek regularly means 'not to be alarmed', 'to face a thing without funk', e.g. θαρρεῖν τὸν θάνατον. Hence it stands here for ungrounded confidence, as φόβος stands for ungrounded diffidence, about the future. It is a kind of ἡδονή, as φόβος is a kind of λύπη, which has τὸ μέλλον for its object.

69 d 3–4. ἐλπίδα δ' εὐπαράγωγον. A.-H. 'hope that lightly leads astray'. But (*a*) ἐλπίς, when not defined further by the context, means simply anticipation whether of good or evil, and one may be misled by

either; the meaning here should rather be 'fancy'. (*b*) εὐπαράγωγος is probably passive, as it is in Aristoph. *Eq.* 1115 εὐπαράγωγος εἶ, | θωπευόμενός τε χαίλρεις, 'you are an easy gull and actually like being fawned on and cheated'. The active sense of the word is only supported by L. and S. with a single reference from Philo Judaeus. Tr. then, in all probability, 'fancy, easily led astray'.

69 d 4–5. ἐπιχειρητῇ παντὸς ἔρωτι. A.-H. 'love that ventures all things'. But ἔρως does not mean 'love' in the sense such a phrase suggests, and ἐπιχειρεῖν properly means to 'attack'. What πάντων ἐπιχειρητής must mean we see from such words and expressions as πανοῦργος, πᾶν τολμᾶν, πᾶν ποιεῖν ὥστε. Tr. 'dare-devil lust'.

69 d 6—70 a 2. καὶ διὰ ταῦτα . . . τιθέντες. The picture is that of a palace or court on an island, connected by a narrow isthmus with the mainland, where the general population of the city lives and its business is carried on. At the point nearest to the isthmus are the barracks for the guards of the monarch, who himself lives in the palace. So the head, which contains the brain and the 'circles' of the Same and Other, is the island palace inhabited by the rightful monarch of the city of Mansoul, the 'divine' εἶδος in the ψυχή, the λογιστικόν. The isthmus is the neck, the cavity of the chest corresponds with the quarters of the guards, who must, of course, be posted between the seat of sovereignty and the business quarter, so that there may be ready and constant communication between the monarch and his executive. The lower part of the trunk, the seat of the ἐπιθυμητικόν, answers to the business and residential quarters of the city. Plato is very possibly thinking of the actual disposition of Syracuse, which he knew familiarly. The seat of administration there was precisely on an island joined to the mainland by a fortified causeway. Contrast Aristot. *de partibus Animal.* Δ. 691^{b} 18, where the use of the neck is less fancifully explained to be that it serves as a protection for the ἀρτηρία or wind-pipe.

69 e 4. τῷ καλουμένῳ θώρακι. τῷ καλουμένῳ is a sort of semi-apology for the use of a word which belongs to the technical vocabulary of a τέχνη or 'craft', in this case the ἰατρικὴ τέχνη. θώραξ here, as we see from what immediately follows, means the whole cavity of the trunk, not merely the part of it which lies above the diaphragm, for which the more precise name would be, as A.-H. says, στῆθος. For this extended use of θώραξ we may compare Hippocrates περὶ τέχνης (Kühn) i. 17, ὅ τε γὰρ θώρηξ καλούμενος, ἐν ᾧ τὸ ἧπαρ στεγάζεται, Aristot. *Hist. Animal.* A. 491^{a} 27, where it is said that the κύτος, which extends from the neck to the genitals, is the part ὃ καλεῖται θώραξ. So, as a military term, θώραξ, like the Latin *lorica*, means 'body-armour'. The θώρηξ of a Homeric warrior was much more than a 'chest-protector'. The use of καλούμενος with 'words of art' is very common, even in writers like those of the Hippocratic *corpus* who, as themselves τεχνῖται, might be expected to have little compunction about the employment of 'technicalities'. Cf. the example already quoted from the περὶ τέχνης. In Plato himself we have such approximate parallels as *Sympos.* 190 e 7 ἐπὶ τὴν γαστέρα νῦν καλουμένην, ib. 218 a 3 τὴν καρδίαν γὰρ ἢ ψυχὴν ἢ ὅτι δεῖ αὐτὸ ὀνόμασαι πληγείς. Xenophon (*Mem.* A. 1. 11) speaks of ὁ καλούμενος ὑπὸ τῶν σοφιστῶν

κόσμος. With Aristotle this use of καλούμενος has become a standing mannerism. (See Bonitz *Index Aristot.* s.v. καλεῖν.) We even get such phrases as ὁ καλούμενος ἀήρ, τὰ καλούμενα ἄστρα, τὸ καλούμενον γάλα. More than once the Pythagoreans are described as οἱ καλούμενοι Πυθαγόρειοι, 'the P., as they are called'. The most striking example is perhaps ὁ καλούμενος νοῦς (*de Anima* A. 407ᵃ 4) or ὁ καλούμενος τῆς ψυχῆς νοῦς (ib. Γ. 429ᵃ 22). Aristotle is, in fact, half apologizing for the employment of a technical word, which, indeed, comes from the special vocabulary of Anaxagoras, who has just been mentioned in the second of the two passages referred to. (In ordinary Attic νοῦς does not mean 'the mind'. It usually means either 'sense', as in such phrases as νοῦν ἔχειν, or else the 'purport' of a statement, the 'intention' of an agent and the like. The use of the word to stand for 'mind' is a technicality originating with Anaxagoras and familiar to us mainly because Aristotle adopted the word in his psychology. In Plato it would probably be safe to say that νοῦς never means 'mind' and still less 'a mind'. The word for this with him is ψυχή or διάνοια, just as 'to think' is διανοεῖσθαι. In the older (Ionic) terminology of the fifth century the corresponding word was usually γνώμη. This explains why there is no plural to νοῦς in *classical* prose.) Similarly we read in Aristotle of ἡ καλουμένη ὄρεξις, because ὄρεξις is a technical 'word of art', in this case a technicality of Aristotle's own scientific vocabulary.

70 a 1. οἷον γυναικῶν, τὴν δὲ ἀνδρῶν χωρὶς οἴκησιν = οἷον οἰκήσεις, τὴν μὲν γυναικῶν, τὴν δὲ ἀνδρῶν χωρίς. There is an intentional allusion to the ἀνδρεία which is the characteristic virtue of θυμός, hence A.-H. should not have said that it is not clear which of the two divisions is the 'women's apartments'. Martin was probably led by the perception of this allusion to his names *l'âme mâle* and *l'âme femelle* for the elements of θυμός and ἐπιθυμία. The names do not occur anywhere in T.'s exposition and are better avoided, but they are not wholly inappropriate. The same simile of the party-wall is used by Aristotle in his account of the diaphragm, *de partibus Animal.* Γ. 672ᵇ 19 ἐπὶ γὰρ τοῦτο διέλαβεν ἡ φύσις, οἷον παροικοδόμημα ποιήσασα καὶ φραγμὸν τὰς φρένας, καὶ διεῖλε τό τε τιμιώτερον καὶ τὸ ἀτιμότερον, ἐν ὅσοις ἐνδέχεται διελεῖν τὸ ἄνω καὶ κάτω· τὸ μὲν γὰρ ἄνω ἐστὶν οὗ ἕνεκεν καὶ βέλτιον, τὸ δὲ κάτω τὸ τούτου ἕνεκεν καὶ ἀναγκαῖον, τὸ τῆς τροφῆς δεκτικόν. Aristotle is here consciously echoing the language of Timaeus. The 'better' element which is housed in the thorax is with him the 'sensitive' soul (with the *heart* for its centre), the 'worse' is the merely 'nutritive'. With him the object of the separation is to prevent the functions of sense from being disturbed by 'vapours' arising from the process of digestion (ὅπως ἡ τῆς αἰσθητικῆς ψυχῆς ἀρχὴ ἀπαθὴς ᾖ καὶ μὴ ταχὺ καταλαμβάνηται διὰ τὴν ἀπὸ τῆς τροφῆς γινομένην ἀναθυμίασιν καὶ τὸ πλῆθος τῆς ἐπεισάκτου θερμότητος, loc. cit. ᵇ 16). Ar. thus reproduces the theory of Timaeus with such modification as is required by his own adherence to the view that the heart, not the brain, is the centre of the sensory system.

ib. **διάφραγμα.** 'As a partition'; the word is not yet technically specialized to mean the particular διάφραγμα constituted by the φρένες.

70 a 2–3. τὸ μετέχον οὖν τῆς ψυχῆς ἀνδρείας καὶ θυμοῦ. That is, τὸ τῆς

ψυχῆς (partitive gen.). *μετέχον ἀν. καὶ θ.*, 'the manly and spirited part' of the ψυχή. The words show that there was an allusion to *ἀνδρεία* in the preceding reference to 'men's quarters'. *θυμός* is compared with a force in garrison so posted that it has its communications with the supreme authority always open, and can hold the fortified part of the city against the rabble in the case of an *émeute*. Aristotle seems to be alluding to the simile, but using it against T.'s physiological psychology when he says (*de Iuventute* 469^{a} 33) that the heart, as the common centre, is placed in the middle of the body because that is the right place for a central government; 'the middle position of such a principle is the proper position *for a ruler*', *ἔστιν ἡ τοῦ τοιούτου μέση χώρα ἄρχοντος χώρα.*

70 a 3. φιλόνικον ὄν. Not 'warlike' (A.-H.) but 'emulous of victory', 'ambitious'. It is clear from *Rep.* ix. 551 a, *al.* that Plato connected the adjective φιλόνικος with *νίκη*, not with *νεῖκος*. *θυμός* is the element in each of us in virtue of which we aim at 'mastery' in all sorts of undertakings, try to do a thing better than other competitors, and always to be doing it better than we ourselves have ever done it before. Hence the characteristic 'end' or satisfaction for this element in us is *τιμή*, and the φιλότιμος *βίος*, the life of the man in whom this element is dominant, is called also the φιλόνικος *βίος*. Cf. particularly *Rep.* ix. 581 a 9 *τί δέ; τὸ θυμοειδὲς οὐ πρὸς τὸ κρατεῖν μέντοι φαμὲν καὶ νικᾶν καὶ εὐδοκιμεῖν ἀεὶ ὅλον ὥρμῆσθαι;—καὶ μάλα.—εἰ οὖν φιλόνικον αὐτὸ καὶ φιλότιμον προσαγορεύοιμεν, ἢ ἐμμελῶς ἂν ἔχοι;—ἐμμελέστατα μὲν οὖν.* The spelling of the word with the diphthong *ει* is a mere error. At the date of our oldest Plato MSS. there was a standing tendency to write even a short *ι* as *ει*. Thus the Bodleian MSS. regularly writes *Παρμενείδης* for the philosopher's name, though the quantity of the *ι* is certain from the scansion $-\cup\cup-$ in an extant hexameter verse of Timon of Phlius.

70 b 1. ἅμμα τῶν φλεβῶν. Because they all meet there. The *ἀρχὴν ἅμα* of inferior texts is a mere blundering attempt at restoring the sense which had been destroyed by the corruption of *ἅμμα* to *ἅμα* (F W). The genuine reading is adequately attested since it has the concurrent support of A P Y. Timaeus, we must remember, knows nothing of the distinction between 'veins' and 'arteries'; φλέβες includes both. According to the so-called 'Philolaus' (Fr. 13 = R. P. 85) a rational animal has four *ἀρχαί*, the brain, which is the seat of *νοῦς*, the heart, the seat of *ψυχή* and *αἴσθησις*, the navel, the source of the first growth of the embryo, and the *αἰδοῖον*, the *ἀρχή* of procreation. That is, the brain is the *ἀρχή* of our specifically *human* life, the heart of *animal* life, the navel of our 'vegetative' life, and the *αἰδοῖον* of all three at once. If this is a piece of genuine old Pythagorean physiology, it is not closely followed by Timaeus. As his first generation are sprung from the soil (*αὐτόχθονες*), and the difference of sex only arises in the second generation, he takes no account of navel or *αἰδοῖον* in describing their anatomy, and *sensation* is connected, as by Alcmaeon, not with the heart but with the brain. The centre of the *ἐπιθυμητικόν* is neither heart nor navel but liver. The attempted 'emendation' of the corrupted *ἅμα* to *ἀρχὴν ἅμα* was, no doubt, helped by the fact that Aristotle repeatedly calls the heart *ἀρχὴ τῶν φλεβῶν*. Galen clearly knew nothing of the reading *ἀρχὴν*

ἅμα nor yet of the true text ἄμμα. He quotes the passage three times with ἅμα alone in Book VI of his work *de Hippocratis et Platonis placitis*. If he had known of a reading ἄμμα he would have been obliged to discuss it, since the whole of the book in question is a polemic against the view that the heart *is* the meeting-place of the blood-vessels. Galen's own theory, supported by appeals to Hippocrates περὶ χυμῶν and to anatomy, is that the *liver* is the ἀρχὴ τοῦ αἵματος, the place where the body's blood-supply is manufactured. He assumes that Plato shared this view. Consequently he says that by the φλέβες in this passage Timaeus really means 'arteries', and sees an allusion to their pulsation in the σφοδρῶς. He then tries to find his own view of the liver as the centre of the veins in the words of 70 e 2 οἷον φάτνην . . . τεκτηνάμενοι. Here he is clearly without justification. There can be no real doubt that T. means to include both veins and arteries under φλέβες and is unaware of the distinction between them. At 70 e the φάτνη is not the liver but the whole region between φρένες and navel, and in the account of the liver 71 a ff. nothing whatever is said of any function except that of causing dreams and visions. T. plainly means to make the heart alone the ἀρχὴ τοῦ αἵματος, and does *not* regard the liver as the 'seat' of the ἐπιθυμητικόν, though it is placed 'in the abode' of that part of the soul.

70 b 4–5. ὥς τις . . . ἐπιθυμιῶν. The αὐτά in περὶ αὐτά clearly refers to τὰ μέλη. The ἄδικος πρᾶξις ἔξωθεν must mean some 'mishandling' of them, some unwarrantable interference on the part of some one else, who is thus 'taking a liberty', committing ὕβρις upon one. So the whole phrase agrees with the account of θυμός in *Rep.* iv where resentment of wrong done *to* us and self-disgust at wrong done *by* us are specified as the two typical manifestations of θυμός (440 a 8 ὅταν βιάζωνταί τινα παρὰ τὸν λογισμὸν ἐπιθυμίαι, λοιδοροῦντά τε αὐτὸν καὶ θυμούμενον τῷ βιαζομένῳ ἐν αὐτῷ κτλ., ib. c 7 τί δ' ὅταν ἀδικεῖσθαί τις ἡγῆται; οὐκ ἐν τούτῳ ζεῖ τε καὶ χαλεπαίνει καὶ συμμαχεῖ τῷ δοκοῦντι δικαίῳ κτλ.). Thus what θυμός resents is always βία, 'violation of the rights' of the λογιστικόν, but this βία may be exercised either by a man's own ἐπιθυμητικόν or by a second person.

70 b 5–6. διὰ πάντων τῶν στενωπῶν. The reference is to the innervation of the whole body to resistance. Timaeus apparently thinks the tonic character of the experience directly due to a violent surging of the blood from the heart through the narrow conduits of the φλέβες. The language about the στενωποί and the παρακελεύσεις is purposely chosen to keep up the original metaphor. The royal 'guards' are thought of as making their way into all the narrow alleys of the city to quell a disturbance.

70 c 1–d 6. τῇ δὲ δὴ πηδήσει . . . ὑπηρετεῖν. It is explained that the main use of the lungs—though reference is also made to their connexion with breathing—is to prevent the heart from being injured by its violent throbbing under excitement by providing a soft and yielding 'cushion' or 'buffer'. We might wonder that breathing is thus made only a secondary function of the lungs, but we shall see later that this is due to the influence of Empedocles. E. held that we breathe through our whole skin, and T., as we shall see, accepts this doctrine. The notion mentioned at c 7 that drink is received into the lungs, though a mere

error, is one which was current among some of the medical men of the fifth century. The author of the Hippocratic *περὶ καρδίης* offers an experimental proof of the fact. He says that if you give a pig a coloured liquid to drink and cut its throat while it is still drinking, you will find the windpipe discoloured, *εἰ ἔτι πίνοντος ἀνατέμοις τὸν λαιμὸν εὕροις ἂν τοῦτον κεχρωσμένον τῷ ποτῷ*. He admits, by implication, that the theory was denied by other medical men, since he adds *ἀλλ' οὐ παντὸς ἀνδρὸς ἡ χειρουργίη* (Kühn i. 485). That the theory, however, was fashionable is shown by the length at which it is refuted by the author of the fourth book of the Hippocratic *περὶ νόσων* (Kühn ii. 373–6). In Plutarch's *Quaest. Conviv.* vii. 1. 698 a ff., an attempt is made to defend Plato in which the Sicilian physician Philistion is named as holding the theory. Since Philistion was a personal friend of Plato (see *Epp.* ii. 314 e 1), and a Locrian, we get an interesting hint about the sources on which the medical part of the dialogue is based. Obviously the alleged fact, if it is a fact, does not prove anything about the lungs as a receptacle for liquid. If Galen, quoted on this passage by A.-H., meant to reassert the theory, and it is not clear that he did, he made a mistake.[1] Aristotle takes the trouble to refute what he calls a 'silly' statement about the lungs at *de partibus Animal.* B. 664^b 7. He would do so with the more gusto that the statement is countenanced in the *Timaeus*.

70 c 3. οἴδησις. All the good MSS. agree in *οἴκησις*, which is also supported by Galen. This is thus a clear case of pre-archetypal corruption. *οἴδησις* in the *late* MSS. is an 'emendation', not a case of preservation of the original text.

70 c 5–6. μαλακὴν καὶ ἄναιμον. A curious blunder. Aristotle is clearly alluding to this passage when he says (*H.A.* A. 496^b 5) that 'those who believe the lungs to be bloodless' have been misled by dissection. The blood escapes from the lungs to the heart at death, and this is why the lungs on dissection appear bloodless.

70 d 2. τῆς ἀρτηρίας. The *ἀρτηρία*, as most often in early Greek, means the *τραχεῖα ἀρτηρία*, the trachea or windpipe. Nothing was as yet known of the distinction between arteries, in our sense of the word, and veins. Both were *φλέβες*.[2]

[1] The passage occurs at the close of *de Hippocratis et Platonis placitis* viii. 728 (Kühn 719). Galen repeats the statement about the pig almost in the words of the *περὶ καρδίης*. He does not say that he had tried the experiment himself. He has just suggested one which he obviously had tried, viz. to take water in your mouth, lie down on your back, and then gently open the orifice of the larynx. You will find that a drop or two of the water 'goes the wrong way'. Galen's object is merely to prove that even if Plato made a mistake, it was not an absurd one. I suspect that he simply copied the passage about the other experiment from the *περὶ καρδίης* without testing the allegation for himself.

[2] The distinction between *ἀρτηρίαι* and *φλέβες*, unknown to Timaeus, appears at times in the Hippocratean *corpus*, notably in *περὶ τροφῆς* (Kühn ii. 22) *ῥίζωσις φλεβῶν ἦπαρ, ῥίζωσις ἀρτηριῶν καρδίη*, a passage insisted on by Galen as showing that Hippocrates held the same view as himself about the connexion between liver and blood-supply. But we do not know the date of this work. The definite fixing of the distinction is presumably connected with the theory of Erasistratus and Praxagoras, that the arteries, as distinguished from the veins, do not contain blood but *πνεῦμα*. *ἀρτηρία*, in any other sense than *trachea*, does not appear to occur in Aristotle outside the spurious *περὶ πνεύματος*. (See Bonitz *Index* s. v.)

70 d 2–3. καὶ περὶ τὴν καρδίαν . . . μάλαγμα. As always in the science of the fifth and fourth centuries, the *πλεύμων* is treated as a single organ, what we call the right or left lung being regarded as one chamber of it. *μάλαγμα* is quite certainly the correct reading, though it has only been recovered from ancient quotations of the passage and appears in no MSS. The word means (1) most commonly a poultice, (2) a soft 'cushion' or 'fender' to break the force of an impact. The second is the sense here. The word was probably rare, and this accounts for the loss of it in our MSS. The *ἅλμα* of A W, *ἄλμα* of F, must be the remains of the four last letters of *μάλαγμα* with the corruption of Γ to Λ. The use of the epithet *μαλακήν* at c 5 is meant to prepare the way for the mention of the *μάλαγμα* and so to make the introduction of the word less harsh. As *μάλαγμα* in the sense of 'fender' or 'cushion' is so rare a word, I may add to the one or two examples given in L. and S. Macrobius *Saturnalia* ii. 4. 12, where we are told that Augustus in a private letter to Maecenas called him, with allusion to his dissolute life, *μάλαγμα moecharum*. Here the word plainly means 'cushion'. There is nothing to be said for the reading of A W *ἅλμα μαλακόν*. A.-H. argues that Aristotle must have known the text of A because, referring to this very passage, he says at *de partibus Animal.* 669ᵃ 18 ff. that the lungs do not exist *πρὸς τὴν ἅλσιν τῆς καρδίας*. But the argument proves nothing, since the *ἅλσις* of Aristotle may equally well be an echo of the *πηδῶσα* of 70 d 4 and the preceding *πηδήσει* of 70 c 1. Aristotle rejects the theory for anatomical reasons and also because man is the only creature who can be influenced by 'forebodings' (cf. *ἐν τῇ τῶν δεινῶν προσδοκίᾳ*). But many other animals besides man have lungs (*ἐν ἀνθρώπῳ τε γὰρ συμβαίνει μόνον ὡς εἰπεῖν τὸ τῆς πηδήσεως διὰ τὸ μόνον ἐν ἐλπίδι γίνεσθαι καὶ προσδοκίᾳ τοῦ μέλλοντος, ἀπέχει τ' ἐν τοῖς πλείστοις πολὺν τόπον καὶ κεῖται τὴν θέσιν ἀνωτέρω τοῦ πλευμόνος, ὥστε μηδὲν συμβάλλεσθαι τὸν πλεύμονα πρὸς τὴν ἅλσιν τῆς καρδίας*).

70 d 7—72 b 5. Τὸ δὲ δὴ σίτων . . . ὀνομάζοιντ' ἄν. *The ἐπιθυμητικόν and its seat.* The 'appetitive' part of the soul has its central abode in the viscera which lie between the midriff and the navel. It is thus housed in the 'belly' like a beast in a 'crib'. It is incapable of intelligence but can be worked on by visions and dreams. The character of these dreams depends on the physical condition of the liver, and the liver and its accessory the spleen have actually been devised for the very purpose of giving this kind of warning to the 'beast' in us, and this is the foundation of all *μαντική*. It is, however, necessary that the warnings of our dreams should be interpreted by sober waking intelligence. The class of interpreters of such things are commonly themselves called *μάντεις*, but it would be more correct to speak of them not as *μάντεις* but as *προφῆται*.

70 d 7. Τὸ δὲ δὴ σίτων τε καὶ ποτῶν ἐπιθυμητικόν. It is usual to specify as the prominent objects of *ἐπιθυμία σῖτα, ποτά*, and *ἀφροδίσια*. The last are purposely not mentioned here because we are dealing with the first generation of men, in whom the distinction of sex has not been made. In the later generations it would be the part of the body of which Timaeus has said nothing, that which lies below the *ὀμφαλός*, which

would be the special region of the *ἀφροδίσια*, but, in his men of the first generation, we must regard the whole of this region as serving merely for the excretion of waste products from the organism.

70 e 2. οἷον φάτνην. A.-H. remarks that the *φάτνη* would suit a horse (he should have said an *ox*; the Greek farmer did not use horses as his beasts of all work) better than that of the wild beast (*θρέμμα ἄγριον*) of which T. goes on to speak. But the representation of the *ἐπιθυμητικόν* as a wild beast is precisely that of the *Republic* (ix. 588 c 7 *πλάττε τοίνυν μίαν μὲν ἰδέαν θηρίου ποικίλου καὶ πολυκεφάλου, ἡμέρων δὲ θηρίων ἐχόντος κεφαλὰς κύκλῳ καὶ ἀγρίων κτλ.*). There the beast is in the care of a farmer (589 b 1 *καὶ τοῦ πολυκεφάλου θρέμματος ἐπιμελήσεται ὥσπερ γεωργός*), who fosters whatever is gentle and docile in it but checks its savage tendencies. An half-tamed creature like this would have a *φάτνη* (just as animals in a 'Zoo' have). There is no oversight; the picture is significant in all its details. Both Socrates and Timaeus know that though the *ἐπιθυμητικόν* may be made a valuable servant, it has to be tamed first. It is as though the farmer had to catch his ox wild and domesticate him before he can plough with him.

What follows is a very curious, and obviously far from wholly serious, speculation about the functions of the liver, the most prominent organ in the region of the body T. is describing. T. starts from two points, (1) that the state of a man's liver has a great deal to do with his dreams, (2) that the liver and its appurtenances were the special part of the sacrificial victim from which Greek *μάντεις* undertook to read the signs of the future. On the strength of this he builds up the following theory. The *ἐπιθυμητικόν* cannot apprehend rational considerations at all. But it can be placated or scared by dreams and visions. God therefore speaks even to it in the only language it can understand. He uses dreams and visions and the appearances in the livers of sacrificial victims to give salutary hints to the *ἐπιθυμητικόν*. But divinations in visions are those of the mentally abnormal, and before they can be utilized, they need to be interpreted by some one who does not share the vision-seer's abnormality. We might be tempted either to treat this theory as a device for bolstering up superstition or to find in it an anticipation of 'psycho-analysis', according to our bias. But in the mouth of Plato, who held a low opinion of the *μάντις*, the doctrine amounts to little more than a politely ironical refusal to preach a 'rationalistic' crusade against the belief in prophetic dreams, accompanied by the recognition that our dreams may really afford an expert useful evidence of our bodily condition. In the mouth of a fifth-century Pythagorean the doctrine might well be meant more seriously, though the actual phrases used by T. show that he, at least, does not rate the significance of dreams very high. Even Socrates, as we see from the *Crito* and *Phaedo*, was not disinclined to think his dream of the woman in white, who told him he would shortly 'reach Phthia', a heaven-sent hint that the 'sacred trireme' was on its way home, and that his time was short. And he took care not to disobey the dream which told him to 'practise music' in the prison. So (*Rep.* ix. 572 a) he says that the good man is 'closely conversant with reality' in his sleep, and his dreams are *ἥκιστα παράνομοι*, as little extravagant as dreams can be, whereas (571 c–d), when the

wicked man sleeps, he feels freer than ever from all restraint, and his dreams are nightmares of lust and blood.

The belief in the prophetic character of dreams is old and universally diffused. In the Greek world it is specially connected with the Orphic belief that the *ψυχή*—the immortal thing housed in us—is quite dissociated from our working life. It sleeps while the body wakes and vice versa. This is, in fact, the primary meaning of the Orphic saying that the body (*σῶμα*) is the tomb (*σῆμα*) of the *ψυχή*. Pindar gives the theory exactly when he says (Fr. 131) 'the body of every man follows mighty Death, but there is still left alive a shadow of his living self (*αἰῶνος εἴδωλον*). For that alone comes from God. It sleeps while our limbs are doing (*εὕδει πρασσόντων μελέων*), but while men sleep it shows them in many a dream the coming issues of weal and woe' (*τερπνῶν ἐφέρποισαν χαλεπῶν τε κρίσιν*). The *εἴδωλον αἰῶνος* is the *ψυχή*, the 'shade' or *Doppelgänger* of the living man. The belief was not confined to Orphic votaries, but could influence serious scientific men. Thus 'the writer of the Hippocratean *περὶ ἐνυπνίων* begins (Kühn ii. 1) by setting forth the very similar view that it is only in sleep that the *ψυχή* becomes her own mistress and functions freely. *ὅταν μὲν οὖν σώματι ὑπηρετοῦσα ᾖ, ἐπὶ πολλὰ μεριζομένη οὐ γίγνεται αὐτὴ ἑαυτῆς ἀλλ' ἀποδίδωσί τι μέρος ἑκάστῳ τοῦ σώματος, ἥγουν τοῖσιν αἰσθητηρίοισιν, ἀκοῇ, ὄψει, ψαύσει, ὁδοιπορίῃ, πρήξει, καὶ πάσῃ τῇ τοῦ σώματος διανοίῃ, αὐτὴ δ' ἑαυτῆς ἡ διάνοια οὐ γίνεται· ὁκόταν δὲ τὸ σῶμα ἡσυχασθῇ, ἡ ψυχὴ κινευμένη καὶ ἐπεξέρπουσα τὰ μέρη τοῦ σώματος διοικεῖ τὸν ἑαυτῆς οἶκον καὶ τὰς τοῦ σώματος πρήξιας ἁπάσας αὖτη* (l. *αὐτὴ*) *διαπρήσσεται. τὸ μὲν γὰρ σῶμα καθεῦδον οὐκ αἰσθάνεται, ἡ δὲ γρηγοροῦσα γινώσκει καθορῇ τε τὰ ὁρατὰ καὶ διακούει τὰ ἀκουστά, βαδίζει, ψαύει, λυπεῖται, ἐνθυμέεται, ἐν ὀλίγῳ ὁκόσαι τοῦ σώματος ὑπηρεσίαι ἢ τῆς ψυχῆς, ταῦτα πάντα ἡ ψυχὴ ἐν τῷ ὕπνῳ διαπρήσσεται. ὅστις οὖν ἐπίσταται κρίνειν ταῦτα ὀρθῶς μέγα μέρος ἐπίσταται σοφίης.* Here we have the same theory as in Pindar. The waking consciousness is regarded as something quite distinct from the *ψυχή* and spoken of as a function of the body (the *διάνοια τοῦ σώματος*), not of this divine inhabitant of the 'house'. Equally of course, in the most matter-of-fact of the Hippocratean writings, where nothing is said of the divine *ψυχή*, we find the authors dwelling on the point that a patient's dreams are among the symptoms on which a wise physician will base his anticipation of death or recovery.

Knowing what we do of the Pythagorean religion of the fifth century, we should be surprised if the Pythagoreans did not reproduce this theory of the sleep of the body as the time when the soul is most awake, and if their scientific men did not try to find some theoretical justification for it.

In Diogenes Laertius (viii. 24) one of the rationalizing explanations offered of the famous taboo on beans, usually ascribed to the Pythagoreans, is that they cause troubled dreams (*κοσμιωτέρας ἀπεργάζεσθαι τὰς γαστέρας μὴ παραληφθέντας· καὶ διὰ τοῦτο καὶ τὰς καθ' ὕπνους φαντασίας λείας καὶ ἀταράχους ἀποτελεῖν*). It is added (ib. 32) that Pythagoreans taught that dreams are sent by 'spirits' and 'heroes', of whom the air is full (*εἶναί τε πάντα τὸν ἀέρα ψυχῶν ἔμπλεων· καὶ τούτους δαίμονάς τε καὶ ἥρωας νομίζεσθαι· καὶ ὑπὸ τούτων πέμπεσθαι ἀνθρώποις τούς τε ὀνείρους καὶ τὰ*

σημεῖα νόσου τε καὶ ὑγιείας), a point reproduced in the *Symposium* in the discourse of the prophetess Diotima when she says that intercourse with God is effected by these spirits 'as well for the sleeping as the waking', καὶ ἐγρηγορόσι καὶ καθεύδουσι (*Sympos.* 203 a 3). (The belief is not *distinctively* Pythagorean or Orphic. 'Heroes' such as Asclepius and Trophonius were regularly supposed to impart communications in dreams to those who slept in their sacred precincts.) In Porphyry's *Life of Pythagoras* we are told that Pythagoras was supposed to have learned the art of interpreting dreams on his (apocryphal) travels in Egypt, Arabia, and Palestine. (Porphyry is perhaps thinking of the fame of Joseph and Daniel as successful expounders of dreams.) Iamblichus says (*V. P.* 65) that he trained his disciples to compose their minds by evening music with a view to detaching them from the turmoil of worldly business, and so purified their understanding and made their sleep 'easy and full of pleasant dreams and even prophetic' (ἡσύχους τε καὶ εὐονείρους ἔτι δὲ μαντικοὺς τοὺς ὕπνους αὐτοῖς ἀπειργάζετο). Ib. 106–7 we are told that Pythagoras forbade all such articles of diet as interfere with μαντική, the art of the diviner, and those which 'make the soul turbid in respect of the appearances in dreams'; at 114 that the Pythagoreans used to induce good dreams at night by suitable music. At 139 there is a story of a man who asked Pythagoras about the interpretation of a dream in which he had conversed with his dead father. We may probably infer that, for all his anxiety not to overrate the revelations made in dreams, Timaeus, as distinguished from Plato, is meant to be in the main serious in his account of the way in which God uses the liver to give the ἐπιθυμητικόν warnings in the night season. Democritus is quoted as attaching importance to the εἴδωλα seen in dreams and as praying for εὔλογχα εἴδωλα, 'fortunate dreams' (Fr. 166 ap. Sextus *adv. Mathemat.* ix. 19, R. P. 203). This seems to me one of the many indications of the close connexion between Atomism and Pythagoreanism. As for Plato, in the myth of the *Phaedrus* it is noticeable that in the passage (248 d–e), where he enumerates ten 'lives' or 'callings' in their order of worth, μάντεις and 'initiators' are given only the fifth place, below physicians and experts on physical culture. All the callings which rank below theirs are such as Socrates, who is the speaker, thought poorly of, the poet, the mere industrial, the sophist and the demagogue, the 'tyrant'. It is still more noticeable that in the later dialogues, where the chief speaker is not an historical person of the fifth century, there is nothing to be found suggesting that dreams and μαντική have any serious worth. The *Laws* is silent on the subject, and so, naturally, are the *Sophistes* and *Philebus*. The *Politicus* merely refers with open irony (290 c–d) to the 'prestige' and 'imposing claims' (the σχῆμα and σεμνὴ δόξα) of the priest and the μάντις. Even Socrates had been made (*Phaedrus* 244–5) to treat the seer, along with the poet, as an 'inspired madman'. All this is the more significant that the passage about the different 'lives' in the *Phaedrus* seems to be a correction of Empedocles, who had given the first rank of all to the μάντις (Fr. 146, R. P. 181 c εἰς δὲ τέλος μάντεις τε καὶ ὑμνοπόλοι καὶ ἰητροὶ | καὶ πρόμοι ἀνθρώποισιν ἐπιχθονίοισι πέλονται). So we can draw no inference from the attitude of Timaeus to Plato's. He would apparently

have been much more in sympathy with the spirit of Aristotle's two little essays on *Dreams* and *Divination by Dreams*. Aristotle accounts for dreams physiologically without bringing in the liver at all. They are due to residual motions in the central or common sensorium, which is the heart. In ordinary waking life this centre is stimulated by movements of the blood and πνεῦμα or 'animal spirits'—a supposed evaporation from the blood—aroused by the action of external agents on the peripheral sense-organs. But the motions in the central sensorium may go on after the stimulation of the peripheral sense-organ has ceased, and also the central sensorium may be accidentally 'moved' by disturbances arising within the organism, in the blood and animal spirits, exactly as it might have been by actual stimulation of a peripheral sense-organ. This accounts both for 'mental imagery' in waking life and for the 'images' of dreams. As for 'prophetic' or 'veridical' dreams, Aristotle thinks the evidence for them too strong to be wholly set aside, but finds the popular theories about them incredible. The only class of such dreams to which he pays much attention is those which indicate the approach of death or some other crisis in the dreamer's health. Cultivated physicians (does he mean the Sicilian school whose theory of health is so important for his own and Plato's ethics?) rightly attach importance to such dreams, because they are due to constitutional causes. A serious alteration in health modifies the behaviour of the blood and animal spirits. The modifications may often be discovered from the patient's dreams when they would go undetected in waking life, because the more massive movements due to peripheral stimulations mask them. This was the foundation for the practice, common a century ago, of hypnotizing a patient and calling on him to diagnose his condition and prescribe for himself in the hypnotized state. (See the description of the process in Shelley's poem, *The Magnetic Lady to her Patient*, which refers to an experiment of this kind made on himself.) It would also afford some justification for the use made of dreams by our contemporary 'psycho-analysts'. Aristotle accepts the Pythagorean theory that dreams come from 'spirits', δαίμονες, in the very qualified sense that nature itself is something 'daemonic'—'nature' is after all supernatural—but strongly denies that they are sent by God (*de Div. per Somn.* 463^{b} 13 *θεόπεμπτα μὲν οὐκ ἂν εἴη τὰ ἐνύπνια, οὐδὲ γέγονε τούτου χάριν, δαιμόνια μέντοι· ἡ γὰρ φύσις δαιμονία, ἀλλ' οὐ θεία*). If they came from God, you would expect the most vivid visions to be vouchsafed to the best and wisest men, and that they should come in waking life when the intelligence of the recipient is most active. (See Art. Dreams [Greek] in *ERE.* by A. Lang and A. E. Taylor.)

71 a 1–2. περὶ τοῦ πᾶσι κοινῇ καὶ ἰδίᾳ συμφέροντος. The καὶ ἰδίᾳ is one of Bt.'s very few conjectural emendations. The restoration seems to be justified by the considerations that (1) we have to account for the διά in the unmeaning διαξυμφέροντος of W Y and of *Bekker's* F, and the equally unmeaning ξυνδιαφέροντος of the corrector of Y, and also for the καί of Bt.'s F and Bekker's Θ; (2) and in A there is an indication of the loss of some letters before the ξυμφέροντος. Bekker, indeed, records καὶ ἰδίᾳ as an actual marginal note of his *S* and καὶ ἴδια διαξυμφέροντος

as the reading of his *s*. The evidence of W Y makes Bt.'s conjecture certain.

71 a 4. αὐτῶν αἰσθήσεως. This seems to be the only reading with much MSS. support. Bekker and subsequent editors, except A.-H., Bt. and Rivaud, give *αὖ τῶν αἰσθήσεων*, the text of Y and Par. 1812, and this is presupposed by the version of Ficinus, *et si quo sensu pulsaretur*. With the better attested reading *αὐτῶν* means *λόγων* and depends on *αἰσθήσεως*, 'even if it should get any perception of rational discourses'—as it does not—it would pay no heed to them. The rival text *αὖ τῶν αἰσθήσεων* gives an inferior sense, 'even if it were *per contra* (*αὖ*) to apprehend *sensations*, it would pay no heed to *λόγοι*'. T.'s point is the double one that (*a*) the *ἐπιθυμητικόν* cannot apprehend 'discourse' at all, and (*b*) even if it could, it would not be influenced in its behaviour by *λόγοι*.

71 a 6. ψυχαγωγήσοιτο. The literal sense should not be watered down. *ψυχαγωγεῖν* is to 'call up spirits' and the *ψυχαγωγός* is the professional ghost-raiser. The performer worked, sometimes at any rate, with an actual wand which attracted or repelled the ghosts. Thus the 'hypnotist' who, according to the story of Clearchus, gave a performance before Aristotle is said to have 'drawn the *ψυχή*' out of his 'subject' by such a wand (Proclus *in Remp.* Kroll ii. 122 *τῇ γὰρ ῥαβδῷ πλήξας τὸν παῖδα τὴν ψυχὴν ἐξείλκυσεν*). When the words *ψυχαγωγεῖν*, *ψυχαγωγία* are used metaphorically of the plausible demagogue and his likes, who work at their will on the audience whom they hold 'entranced', it is always with a sense of the literal meaning, and the expression is usually meant to indicate dislike and contempt for performer or audience or both. Compare the description of Socrates as a fraudulent ghost-raiser in Aristophanes *Birds* 1553 *λίμνη τις ἔστ' ἄλουτος οὗ | ψυχαγωγεῖ Σωκράτης*. S. is represented as pretending to evoke 'spirits' and Chaerephon as the confederate who impersonates the spirits. The joke is that Pisander, a notorious coward, comes to Socrates to recover the *ψυχή* he had 'given up' in a panic, and the passage is important as evidence independent of Plato that S. was known in his lifetime as a person with unusual views about the destiny of the *ψυχή*. This is also what is meant at *Clouds* 94 when Strepsiades calls the house of Socrates *ψυχῶν σοφῶν φροντιστήριον*. *ψυχῶν* is intended to bear the sense 'ghosts'. So in Euripides Heracles reproaches Admetus with suspecting his friend of being a ghost-raiser (*Alc.* 1127 *ὅρα γε μή τι φάσμα νερτέρων τόδ' ᾖ.—οὐ ψυχαγωγὸν τόνδ' ἐποιήσω ξένον*). All the Platonic examples are of the same kind. Thus when in the *Phaedrus* (261 a 7) rhetoric is described as *ψυχαγωγία τις διὰ λόγων* (cf. ib. 271 c 10), the language is meant to be contemptuous; rhetoric is a kind of verbal 'sorcery'. So in *Laws* x. 909^{b} 2 ff. the indulgence-mongers are said to be scoundrels who, under the pretence of waking the dead 'steal the souls' out of the living (*καταφρονοῦντες δὲ τῶν ἀνθρώπων ψυχαγωγῶσι μὲν πολλοὺς τῶν ζώντων κτλ.*). Cf. Isocrates ii. 49 *δέδεικται τοῖς ἐπιθυμοῦσι τοὺς ἀκροωμένους ψυχαγωγεῖν, ὅτι τοῦ μὲν νουθετεῖν καὶ συμβουλεύειν ἀφεκτέον, τὰ δὲ τοιαῦτα λεκτέον, οἷς ὁρῶσι τοὺς ὄχλους μάλιστα χαίροντας*, ix. 10 *ἃ τοσαύτην ἔχει χάριν, ὥστ' ἂν καὶ τῇ λέξει καὶ τοῖς ἐνθυμήμασιν ἔχῃ κακῶς, ὅμως αὐταῖς ταῖς εὐρυθμίαις καὶ ταῖς συμμετρίαις ψυχαγωγοῦσι τοὺς ἀκούοντας*. To render here by 'led away' (A.-H.) is further unsatisfactory

because the *ἐπιθυμητικόν* can be led right as well as wrong by its visions, and God's very purpose is explained to be to illude it with dreams and visions *for its good*. Tr. 'knowing that it would be under the spell of visions and shadows'.

71 a 7. τούτῳ, αὐτῷ. What is the reference of the pronouns? *τούτῳ* might be, as A.-H. seems to take it, 'this peculiarity', 'this weakness', viz. the tendency of the *ἐπιθυμητικόν* to be affected by visions, and *ἐπιβουλεύσας τούτῳ* might then mean 'lie in wait for this weakness'. Or *τούτῳ* might, as St. holds, mean *τῷ ἐπιθυμητικῷ*, and *ἐπιβουλεύσας τούτῳ*, 'lie in wait for it'. Again, if we adopt the first alternative, *αὐτῷ* might go with *τούτῳ*, 'this very weakness', but more probably should be taken, as St. took it, not with *ἐπιβουλεύσας τούτῳ* but with *συνέστησε* as a dative of 'advantage'. I should then prefer to take *τούτῳ* in the former of the two ways suggested; 'God took His advantage of this weakness and constructed the liver *for* the good of the *ἐπιθυμητικόν*'. (It would be too grotesque to think in this context of the use of the phrase *συνιστάναι τινά τῳ*, 'to introduce one person to another'.) The idea is that God 'lay in wait' for the *ἐπιθυμητικόν* and contrived a beneficial use of its very tendency to illusion.

71 b 1. ἐκείνου. Sc. *τοῦ ἐπιθυμητικοῦ*, not *τοῦ ἥπατος*, which would require *αὐτοῦ*. The *κατοίκησις* keeps up the image of the *ἐπιθυμητικόν* as a beast housed in a cage or lair.

71 b 3 ff. It seems possible to take two divergent views of the construction of the long *ἵνα* clause. (1) The subject may be throughout *ἡ ἐκ τοῦ νοῦ φερομένη δύναμις*, and all the feminine nominative participles may agree with *δύναμις*. (2) A.-H. prefers to regard *παρέχουσα* at c 5 and all the feminine nominative participles which follow as agreeing with *ἐπίπνοια*, only those which precede *παρέχουσα* belonging to *δύναμις*. I should with considerable hesitation incline to the former alternative. But it is impossible to be certain on the point, and most probably Plato had never asked himself the question precisely how he meant his words to be 'construed'. The main idea is that the liver is like a mirror which reflects images. This is the very reason why it was made *λεῖον*, smooth and polished. That in so long and loosely-constructed a sentence, there should be no *δέ* formally answering to the *μέν* with *φοβοῖ* in b 5 calls for no remark.

71 b 6. συγγενεῖ. A.-H. seems clearly wrong about the meaning of this. The *πικρότης* is *συγγενές* to the *liver*, of which we have already been told that it is *πικρότητα ἔχον*. The sense is 'employing something of the liver's own congenital (or innate) bitterness'. So he goes wrong about the phrase in c 6–7 *γλυκύτητι τῇ κατ' ἐκεῖνο συμφύτῳ πρὸς αὐτὸ χρωμένη*. What is meant here is the sweetness which is natural to the *liver* (cf. *γλυκύ* in 71 b 2), not the *γλυκύτης* of the *ἐπίπνοια*. St. is hardly using too strong a word when he calls this interpretation of the words *συγγενεῖ* and *συμφύτῳ* in our passage ridiculous. The whole point is that the liver itself was made bitter-sweet because there would be a use for both of these properties.

71 b 7. κατὰ πᾶν . . . τὸ ἧπαρ. Sc. *ὑπομειγνῦσα*, 'infusing it (*τὴν πικρότητα*) all over the liver'.

71 b 8. ἐμφαίνοι. Not simply 'display' but 'throw on the liver', which has already been compared with a mirror, 'bilious colours'. *ἐμφαίνειν* is the proper technical term for casting a reflection, as *ἐμφαίνεσθαι* is the technical word for 'to be reflected in' a mirror and *ἔμφασις* for the 'reflection' or 'image'.

71 c 1–2. τὸ μὲν . . . τὰ δέ. This appears from Bekker's collations to be the only reading with any MSS. authority. *τὸ μέν*, 'the one part' (of the liver), will refer to the *λοβός*, *τὰ δέ*, 'the other parts' to the *πύλαι*, and *δοχαί*. Thus *λοβόν*, *δοχάς* and *πύλας* will be in anticipatory apposition to *τὸ μέν* and *τὰ δέ*. The proposal to write *τὸν μέν* for *τὸ μέν* is superfluous. With the inferior reading of many editors *τὰ μὲν . . . τὰ δέ* the accusatives will be adverbial, 'partly . . . partly' (as Ficinus renders).

71 d 2. εὐήμερον. Commonly regarded as an instance of *εὐήμερος*, 'fortunate', 'happy' (from *ἡμέρα*), and quoted as an example of the word in L. and S. But, since the *ἐπιθυμητικόν* has been all through likened to an imperfectly tamed animal, is it certain that we are not meant to connect the epithet with *ἥμερος*? *ἥμερα ζῷα* are 'domesticated' animals as opposed to those in a state of natural wildness, *ἄγρια ζῷα*. The word in this sense would apparently be *ἅπαξ λεγόμενον*, but would be in form exactly similar to e. g. *εὔδηλος*, and I find it difficult not to suspect that this is what Plato intends, especially as, if we think of the connexion with *ἡμέρα*, there is an unavoidable false antithesis with the *ἐν τῇ νυκτί* of the following clause.

71 d 4. ἐπειδὴ λόγου καὶ φρονήσεως οὐ μετεῖχε. *μαντική* is at best a kind of guess-work, and therefore a much inferior thing to sober and rational understanding. Timaeus is quite free from the tendency to regard the enigmatical and mysterious, as such, as superior to the results of lucid thinking. The *ἐπιθυμητικόν* is permitted to be, in favourable conditions, 'prophetic' in dreams as a kind of consolation or compensation for its misfortune in being incapable of thought and reflection. Cf. below *κατορθοῦντες καὶ τὸ φαῦλον ἡμῶν, ἵνα ἀληθείας πῃ προσάπτοιτο*. Aristotle attacks this account of the use of *χολή* in *de partibus Animal.* Δ. 676^{b} 22 ff. 'There are no good grounds for the view of some who say that the gall (*χολή*) exists for the sake of some sort of sense-perception. They say that its function is, when it is coagulated, to prick that part of the soul which is lodged about the liver, and to make it cheerful (*ἵλεων*, a verbal echo of Plato) when it flows freely. Now some animals have no gall at all, e. g. the horse, mule, ass, deer, roe. And the camel has no distinct gall, though it has small biliary ducts. Nor has the seal nor the dolphin a gall. And even within the same genus, some individuals have it and some have not. This is the case with mice, and also with men.' According to Dr. Ogle, in his notes to his version of this passage, Aristotle's statements are in the main correct, except for his assertion about man. From other passages it appears that Aristotle regarded the presence of a gall-bladder in man as a rare abnormality, whereas it is the absence of the organ which is exceptional. This makes his argument against T.'s theory of the function of the *χολή* unsound. For T. regards man as the starting-point of the whole evolutionary process, and could

readily account for the absence of the gall-bladder in other species as a case of 'evolution by degeneration'.

Aristotle's own theory was that χολή, like e.g. urine, is a mere residual or waste product which is of no use in the organism. So he says (*de partibus Animal.* Δ. 677ᵃ 11), 'it is most probable that χολή in the liver, like that found elsewhere in the body is a kind of excretion (περίττωμα) and does not exist for the sake of anything, any more than the deposits in the stomach and intestines. It is true, to be sure, that nature sometimes employs even excrements for a useful purpose, but all the same we should not look for a purpose in all her arrangements. In many cases one thing is a mere necessary consequence of others' (τινῶν ὄντων τοιούτων ἕτερα ἐξ ἀνάγκης συμβαίνει διὰ ταῦτα πολλά). He means that e.g. eating and drinking subserve a useful end, the repair of bodily tissue. Since we have to take in nourishment for this purpose, the refuse left over must be ejected. But it would be wrong to ask what further purpose is subserved by this refuse.

71 e 2. ἀφροσύνῃ. I doubt whether this is meant to be *altogether* ironical. The thought is that God has not left Himself without a witness even among the great mass of mankind who are incapable of scientific thought. He visits them in dreams and visions of the night. That no one 'prophesies' when he is ἔννους, master of his thoughts, was the standing Greek view. The three conditions in which prophecy occurs are (1) sleep, (2) certain νόσοι, e. g. ventriloquism, ἐγγαστριμυθία, in which the voice professes to be that of a 'spirit-control', and seems to come from the patient's stomach. We hear of such an ἐγγαστρίμυθος in the *Cratylus* (396 d 4), and some of the stories of demoniacs in the Gospels seem to refer to the same disorder. As Bt. has said, Socrates' σημεῖον would probably strike his contemporaries as a νόσος of this kind. (3) Temporary divine 'possession', ἐνθουσιασμός or κατοκωχή, where a θεός is supposed for the time to control the subject's body. The Bacchic 'possession' is the most obvious example. The votary, while the fit lasts, actually feels himself to be and calls himself Βάκχος. Cf. the description of prophecy as one of the four forms of the divine μανία in the *Phaedrus*. We may compare with T.'s view that the prophecy requires to be interpreted by some one who is not in an abnormal state but fully collected, St. Paul's injunction to the Corinthians that they were not to indulge in speaking with 'tongues' unless there were some one present who could interpret to the edification of the audience. γλωσσολαλία would be an example of what T. means here by νόσοι which are prophetic. It is well-known that the same rule was observed at Delphi. The Pythia was supposed to deliver her utterances in a state of frenzy, but they were reduced to sense and metre by the officials of the temple before being communicated to the inquirers.

72 a 4. εὖ καὶ πάλαι. An allusion to the definition of σωφροσύνη as τὰ ἑαυτοῦ πράττειν, 'minding one's own business', with conscious play on the primary meaning of σώφρων, *sobrius, sage*, 'in one's right senses'. The definition is discussed at *Charmides* 161 b 5 ff., where Socrates insinuates that Charmides has learned it from his cousin Critias (the so-called oligarch', grandson of the Critias of our dialogue), and complains that it

is a 'riddle' (*αἴνιγμα*). At 164 d 1 Charmides proposes to emend it by saying that *σωφροσύνη* is *τὸ γιγνώσκειν ἑαυτόν*, to know one's self (i.e. to have a right estimate of one's own points of strength and weakness), and gives as his authority the Delphic inscription *γνῶθι σαυτόν*. This, he says, is meant as a salutation on the god's part to his visitors, and is equivalent to saying *σωφρόνει*, 'I wish you the *mens sana*'. The romance of the *ἑπτὰ σοφοί* ascribed this, along with other ancient Delphic inscriptions, to the combined wisdom of the 'Seven'. Presumably it is this connexion of the saying with the tale of the 'Seven' that explains the *πάλαι* here. Timaeus combines the statements that *σωφροσύνη* is *τὰ ἑαυτοῦ πράττειν* and that it is *γιγνώσκειν ἑαυτόν*.

72 b 1–5. οὓς μάντεις . . . ὀνομάζοιντ' ἄν. Strictly speaking the persons who reduced the 'utterances of the 'entranced' or 'diseased' *μάντεις* to sense and expounded them to the consultant should not be called *μάντεις* but *προφῆται*, 'spokesmen', 'interpreters' of the *μάντις*. Thus Timaeus would call the Pythia *μάντις*, but would give only the name *προφῆται* to the *Δελφῶν ἀριστῆς* who, according to Euripides, *Ion* 415–16, communicated the oracles to the visitors. A.-H. rightly quotes this passage as illustrative of the distinction intended. But his further inferences from it are unfounded. Apparently Timaeus intends to be criticizing some passage in literature in which the name *μάντις* had been given to the mere 'interpreter' of the seer's utterance. Can he be meaning to hint disapproval of the boastful words with which Empedocles opened his poem on *Purifications* (Fr. 112, R. P. 162 f.)? E. claims to be the equal of a god and talks of the crowds who come to him for 'oracles' (*οἱ δ' ἄμ' ἕπονται | μύριοι, ἐξερέοντες ὅπῃ πρὸς κέρδος ἀταρπός, | οἱ μὲν μαντοσυνέων κεχρημένοι κτλ.*).[1] Is it meant that since E. was *ἔννους* all the time, he ought not to have spoken of his 'oracular responses'? or is the allusion to the bestowal of the name *μάντις* in literature, e.g. in Attic tragedy, on figures like Tiresias who merely predicted by rules of art from the flight of birds, the burning of altar-flames, and the like? The opposite inaccuracy of calling the *μάντις* himself a *προφήτης* is common enough. Thus the Pythia is constantly spoken of as *προφῆτις*. E. g. Eur. *Ion* 321 *Φοίβου προφῆτις, μητέρ' ὡς νομίζομεν*, 1322 ff. *θριγκοῦ τοῦδ' ὑπερβάλλω πόδα | Φοίβου προφῆτις*. On the other hand the Pythia uses the more precise expression of herself at Aesch. *Eum.* 33 *μαντεύομαι γὰρ ὡς ἂν ἡγῆται θεός*.'

72 b 6–d 3. ἡ μὲν οὖν φύσις ἧπατος . . . συνίζει. The function of the thin and bloodless spleen is simply to keep the liver bright, like the duster or handkerchief used for polishing a mirror. Hence it absorbs the impurities which form from time to time in the liver, and so may itself become enlarged and cause disease. I read in the 1892 edition of Huxley's *Elementary Lessons in Physiology* that 'we are still (1892) in doubt about the functions of the spleen', though the author suggests that it is the place where the red corpuscles of the blood die and white ones are formed.[2] It seems a simple mistake to call it *ἄναιμος*. Aristotle, who

[1] Cf. Pindar, Fr. 150 (118) *μαντεύεο, Μοῖσα, προφατεύσω δ' ἐγώ*.

[2] I learn from Professor P. T. Herring that though more is known now about

unlike Plato had an early medical training, argues that it aids digestion just because it is full of blood; it attracts superfluous moisture from the viscera and concocts it (*de partibus Animal.* Γ. 670^{b} 4 *ὁ γὰρ σπλὴν ἀντισπᾷ ἐκ τῆς κοιλίας τὰς ἰκμάδας τὰς περιττευούσας, καὶ δύναται συμπέττειν αἱματώδης ὤν. ἂν δὲ τὸ περίττωμα πλεῖον ᾖ ἢ ὀλιγόθερμος ὁ σπλήν, νοσακερὰ γίνεται †πλήρη τροφῆς*). 'The spleen attracts the residual fluids from the stomach and, owing to its blood-like character, is enabled to assist in their concoction (i.e. conversion into blood). Should this residual fluid be too abundant or the heat of the spleen deficient, the body (?) becomes sickly from over-repletion.' Thus Aristotle seems to have been as much in the dark about the functions of the spleen as every one else. A similar theory is given in the Hippocratic *de morbis* iv. (Kühn ii. 333) *φημὶ δέ ἐπὴν ὁ ἄνθρωπος πίνῃ πλέον, ἕλκειν εἰς ἑωυτὸν ἐκ τῆς κοιλίας τοῦ ὕδατος καὶ τὸ σῶμα καὶ τὸν σπλῆνα, καὶ ἢν πλεῖον εἰρύσῃ τοῦ καιροῦ πονέειν αὐτίκα τὸν ἄνθρωπον, καί τοῦτο ἐσαίουσι γινόμενον ὁκόσοι σπληνώδεες τῶν ἀνθρώπων εἰσίν*, ib. Kühn ii. 377 *χωρέει δὲ καὶ τὸ ποτὸν ἐς τὴν κοιλίην, καὶ ἐπὴν πλησθῇ, ὁ σπλὴν τε ἀπ' αὐτῆς δέχεται καὶ διδοῖ ἐς τὰς φλέβας* κτλ.

72 b 7–c 1. καὶ ἔτι μὲν . . . σημαίνειν. That is, T. regards 'divination' from the appearances in the entrails of the sacrificial victim,—regularly practised, e.g. before a combat—as a still more uncertain way of discovering the future than prediction from dreams, because, as the victim is already dead when the inspection takes place, the significant marks on the liver are beginning to fade. He evidently attaches no value at all to this form of *μαντική*. Hence we may reasonably infer that such value as he does ascribe to dreams and the like is mainly what would be admitted by physicians and 'psychiatrists' of our own time. It is curious that Timaeus ascribes *no* true physiological functions to the liver; he treats it as existing purely *μαντικῆς χάριν*. The theory that the liver is the real source of the blood-supply of the body is examined and refuted by Aristotle at *de partibus Animal.* Γ. 666^{a} 24 ff. Aristotle himself assigns to the liver, as to the spleen, the task of 'concoction' of nutriment (ib. 670^{a} 20). How Timaeus supposes this work to be performed we have yet to see. See Martin n. 140 (ii. 301 ff.) for an account of different ancient theories of the functions of the various viscera.

72 c 5. ἐκμαγεῖον. The word is used in a totally different sense from that in which it was applied to the 'matrix' of *γένεσις*. Here it manifestly means a 'duster', kept by the side of a mirror for the purpose of wiping and burnishing it. (As Fraccaroli notes, the words *οἷον κατόπτρῳ* go with *παρεσκευασμένον*, not with the preceding *καθαρόν* as M. by a strange oversight translates.) The word is rare, though found, as I learn, in the medical writers. This sense of the word comes naturally from the corresponding use of the verb *ἐκμάττειν*. Cf. Sophocl. *El.* 445 *ἐμασχαλίσθη κἀπὶ λουτροῖσιν κάρᾳ | κηλῖδας ἐξέμαξεν*, Eur. *H.F.* 1399, *ἀλλ' αἷμα μὴ σοῖς ἐξομόρξωμαι πέπλοις. | —ἔκμασσε, φείδου μηδέν· οὐκ ἀναίνομαι.* The more ordinary word for 'towel', &c., is *χειρόμακτρον*; *ἀπόμακτρον* appears in Aristoph. *Fr.* 712.

the spleen than in 1892, it is still a rather mysterious organ. Since it seems that it acts as a filter in purifying the blood, there is something after all in T.'s comparison of it with the duster used to keep a mirror clean.

72 d 4–8. τὰ μὲν οὖν . . . πεφάσθω. Note that Timaeus once more inserts an emphatic reminder that the theories to which we have just listened are provisional and tentative, and that this will continue to be the case with those he next goes on to propound. As usual, the warning marks a transition to a new topic. So far we have been speaking of the special parts of the body which are the 'seats' of *θυμός* and *ἐπιθυμία*. We are now to enter on the anatomy and physiology of the whole organism. The whole theory of the 'three *εἴδη*' in the *ψυχή*, no less than the speculations about their connexion with certain organs of the body, is thus brought under the head of *εἰκότες λόγοι* as distinct from 'science'. This should not surprise us, since the *ψυχή* itself is a *γιγνόμενον*, a thing 'in the making'. Moreover, as we have seen, the psychology of the *Republic* and *Timaeus* is a popular doctrine, derived from Pythagorean ethics. Plato did not invent it, and it stands in no very close connexion with his own conception of *ψυχή* as 'the motion which moves itself'. He has therefore very good reasons for reminding us that the preceding account of what is *θεῖον* and what *θνητόν* in the *ψυχή* is not final. It is a mistake to try, by special pleading, to exempt the account of the three *εἴδη* from the scope of these methodological reflections.

Aristotle's unwillingness to admit the doubtfulness of any of his theories presents a curious contrast with Plato's frank recognition that his own age is not in a position to formulate any but tentative conclusions in the 'natural' sciences. Aristotle does indeed from time to time speak in his zoological works of questions which cannot as yet be solved because the requisite observations have not been made, but there is perhaps only one place in all his writings where he partly owns that a solution propounded by himself may yet have to be abandoned in the light of a closer acquaintance with facts. This is at *de generat. Animal.* Γ. 760^{b} 28 ff., where he has just been propounding a theory about the process of reproduction in bees. He remarks that the theory seems to be borne out by what is known of these creatures, but that the facts are at present only imperfectly established (*οὐ μὴν εἴληπταί γε τὰ συμβαίνονθ' ἱκανῶς*), and that if we should ever become better acquainted with them, we shall do well to prefer properly substantiated fact to any preconceived theory (*τότε τῇ αἰσθήσει μᾶλλον τῶν λόγων πιστευτέον*). Apparently, this theory of parthenogenesis in bees was the one speculation of all those he has put forth about which he really felt some serious misgivings.

72 e 1—73 a 8. τὸ δ' ἑξῆς . . . τῶν παρ' ἡμῖν. We have now to describe the making of the body. (In the last section we had been told why heart, liver, spleen, lungs were made, but not *how* it was all done.) First of all, the abdomen and bowels exist as a receptacle for the superfluous part (the 'waste products') of our food. Our makers foresaw that we should be prone to eat and drink more than is actually needful; so to prevent the premature destruction of the race by undue repletion, they made the cavity of the abdomen and placed the bowels in it. They made the conduit through which waste products were carried off—the colon—so long and winding precisely that repletion and evacuation might not be too speedy, that we might not have to keep eating afresh before we had got

rid of the superfluities from our last meal, and so live merely to eat and come to our graves without ever developing art and science and the 'life of mind'.

72 e 1. ἦν δὲ . . . ᾗ γέγονεν. Be careful not to take τὸ ἐπίλοιπον τοῦ σώματος together, as if it meant 'the rest of the body'. We have not yet heard about any part of the body ᾗ γέγονε, but only οὗ ἕνεκα γέγονε. T. is now *beginning* the answer to the question πῇ γέγονε τὸ σῶμα; the subject is τὸ τοῦ σώματος, a periphrasis for τὸ σῶμα, and ἐπίλοιπον is the predicate. 'It remains to tell how the body was made.' The force of the imperfect ἦν is that this is the remaining topic which was to be discussed according to our original plan. Cf. 69 c 6 τὸ μετὰ τοῦτο θνητὸν σῶμα περιετόρνευσαν ὄχημά τε πᾶν τὸ σῶμα ἔδοσαν, which seem to be the words to which T. is alluding. T. has told us about one of the two topics mentioned there, the introduction of a θνητὸν εἶδος into the ψυχή, and now proceeds in order to the other, the structure of the body. The ἦν used by Aristotle in definitions and in the familiar phrase τὸ τί ἦν εἶναι for the 'form' of a thing has the same explanation.

73 a 2. ἕξει. Here quite literal 'for the holding of', 'to contain' the superfluity.

ib. τὴν ὀνομαζομένην κάτω κοιλίαν. ὀνομ., like καλούμενος, is an apology for a technical 'word of art', as we might say, 'the abdomen, as doctors call it'. Aristophanes (in 406–5) gets a small joke out of the fact that ἡ κάτω κοιλία is properly a medical technicality when he makes Dionysus say (*Frogs* 485) of the sponge for which he had called in a panic, ostensibly to check palpitations, εἰς τὴν κάτω μου κοιλίαν καθείρπυσεν 'it slipped down to my ab-do-men'.

73 a 3–8. εἴλιξαν . . . παρ' ἡμῖν. We have no right to assume that this explanation of the length of the colon in man and its many windings is more than a playful fancy on Plato's part. It may be that on the part of T., or it may be more. Aristotle clearly had the passage in mind in *de partibus Animal.* Γ. 675ᵃ 18, where he is speaking of the voracity of fishes and observes that the most voracious of all creatures are those in which the intestinal canal is straight and without windings, τὸ δὲ τῶν ἰχθύων γένος ἅπαν, διὰ τὸ ἐνδεεστέρως ἔχειν τὰ περὶ τὴν τῆς τροφῆς ἐργασίαν, ἀλλ' ἄπεπτα διαχωρεῖν, λαίμαργον πρὸς τὴν τροφήν ἐστι, καὶ τῶν ἄλλων δὲ πάντων ὅσα εὐθυέντερα. His modern translator, Dr. Ogle, comments: 'an abnormally short gut is, in fact, a sufficient cause for a ravenous appetite. The remarkably short gut of a fish is, however, probably to be explained by the easy digestibility of their food.' Ar. makes an even more entertaining use of the idea, which reads almost like intentional parody, at *de generat. Animal.* Α. 717ᵃ 20 ff. He mistakenly supposes that the testicles of male animals are no indispensable part of the machinery of reproduction. They exist 'for the sake of the better', a reminiscence of the distinction drawn by Timaeus between the 'necessary' and the 'divine' cause. (λείπεται τοίνυν βελτίονός τινος χάριν.) Their real purpose, he says, is to *retard* the secretion and excretion of the generative fluid, and thus to prepare the way for the development of the moral virtue of σωφροσύνη, just as the length and the windings of the intestine are meant to make us less ravenous in our appetites for food and drink. (ἃ δὲ δεῖ

σωφρονέστερα εἶναι, ὥσπερ ἐκεῖ οὐκ εὐθυέντερα, καὶ ἐνταῦθ' ἕλικας ἔχουσιν οἱ πόροι πρὸς τὸ μὴ λάβρον μήτε ταχεῖαν εἶναι τὴν ἐπιθυμίαν. οἱ δ' ὄρχεις εἰσὶ πρὸς τοῦτο μεμηχανημένοι.)

73 b 1–5. Τὸ δὲ ὀστῶν . . . ἐξ ἄλλων. The fundamental structure from which everything else in the body is derived is the spinal 'marrow', with which the ψυχή is more closely connected than with anything else. Hence we must begin our account of man's anatomy by saying of what this 'marrow' is made. Timaeus proposes to offer a physical theory of the composition of the various 'tissues' of the organism, and to begin with the composition of the μυελός because he regards this as the foundation of all the rest. It is the central thing in the body not only because, as T. supposes, it supplies matter for the other 'tissues', but because the 'cables' by which the ψυχή is moored to the body are attached to it. The two points of first-rate importance in the account which follows are (1) that the continuity of brain and spinal cord is recognized, and (2) that the brain is made the centre of the whole organism. Both truths were rejected by Aristotle, and A.-H. is therefore justified in calling attention to the great superiority of Plato's account of the functions of brain and spinal cord. He should not, however, have spoken as though these doctrines were invented by Plato. The theory of the functions of the brain goes back to Alcmaeon of Crotona, and this explains both why Timaeus is made to champion it and why Socrates in the *Phaedo* (96 b 5) mentions it as having attracted his attention in early life. The important testimonies for Alcmaeon's view are Theophrastus *de Sensu* 26 (*Doxogr. Graec.* 507), 'and he says that all the sense-organs are connected with the brain (ἁπάσας τὰς αἰσθήσεις συνηρτῆσθαί πως πρὸς τὸν ἐγκέφαλον), and this is why they are deranged if it moves or shifts its position (διὸ καὶ πηροῦσθαι κινουμένου καὶ μεταλλάττοντος τὴν χώραν), for then it blocks the passages by which sensations are admitted' (ἐπιλαμβάνειν γὰρ τοὺς πόρους δι' ὧν αἱ αἰσθήσεις); Aetius *Placit.* iv. 17, 1 (*Doxogr. Graec.* 407) 'A. says that the "dominant" part of the soul [τὸ ἡγεμονικόν, a Stoic technical term; in *man* this 'dominant' part is intelligence] is in the brain (ἐν τῷ ἐγκεφάλῳ εἶναι)'; Chalcidius *in Tim.* § 246, where it is said that Alcmaeon had discovered by actual dissection two connexions between the eyes and the brain, which appear, if the account of Ch. is historical, to be the two branches of the optic nerve. In the fifth century the same theory is represented among 'philosophers' by Diogenes of Apollonia, who combined Alcmaeon and Anaxagoras by identifying the νοῦς in man with the 'air in the brain'. (This actual formula is not, so far as I know, found in the existing fragments of Diogenes, but it fairly sums up the theory of perception and thought ascribed to him by Theophrastus, *de Sensu* 39–48, *Doxogr. Graec.* 510 ff.) The general theory is that ἀήρ is the 'divine' in us; it is the air which we inhale from the atmosphere around us which is our 'mind' or 'intelligence', and the brain in particular is a great receptacle for this stock of air. The famous description of the veins quoted from Diogenes by Aristotle (*Hist. Animal.* Γ. 511^{b} 30) comes into the theory, as the special point of it is the view that the brain is the centre of the system; hence the 'air' is carried along with the blood through the whole organism, and this is how

'intelligence' is diffused through the organism, or, as Simplicius puts it (*In Physica* 153, 13 ff.), *νοήσεις γίνονται τοῦ ἀέρος σὺν τῷ αἵματι τὸ ὅλον σῶμα καταλαμβάνοντος διὰ τῶν φλεβῶν*).

The doctrine that the brain is the 'centre of intelligence' was regarded as characteristic of the medical school of Cos, represented in the fifth century by Hippocrates, and is maintained vigorously in more than one work of the Hippocratic *corpus*, sometimes in explicit connexion with the fuller view that it is the 'air in the brain' which is our intelligence. Thus the two views are conjoined in the well-known essay *περὶ ἱερῆς νόσου*. Here the writer says (Kühn i. 609–10) *εἰδέναι δὲ χρὴ ἀνθρώπους ὅτι ἐξ οὐδενὸς ἡμῖν αἱ ἡδοναὶ γίνονται καὶ αἱ εὐφροσύναι καὶ γέλωτες καὶ παιδιαὶ ἢ ἐντεῦθεν* (sc. *ἀπὸ τοῦ ἐγκεφάλου*) *καὶ λῦπαι καὶ ἀνίαι καὶ δυσφροσύναι καὶ κλαυθμοί. καὶ τούτῳ φρονεῦμεν μάλιστα καὶ νοεῦμεν καὶ βλέπομεν καὶ ἀκούομεν καὶ γινώσκομεν τά τε αἰσχρὰ καὶ τὰ καλὰ καὶ τὰ κακὰ καὶ ἀγαθὰ καὶ ἡδέα καὶ ἀηδέα, τὰ μὲν νόμῳ διακρίνοντες, τά δὲ τῷ συμφέροντι αἰσθανόμενοι . . .* The further point is then made (Kühn i. 612) thus, *κατὰ ταῦτα νομίζω τὸν ἐγκέφαλον δύναμιν πλείστην ἔχειν ἐν τῷ ἀνθρώπῳ. οὗτος γὰρ ἡμῖν ἐστι τῶν ἀπὸ τοῦ ἠέρος γινομένων ἑρμηνεύς, ἢν ὑγιαίνων τυγχάνῃ. τὴν δὲ φρόνησιν αὐτῷ ὁ ἠὴρ παρέχεται . . . γίνεται γὰρ παντὶ τῷ σώματι τῆς φρονήσιος ὡς ἂν μετέχῃ τοῦ ἠέρος. ἐς δὲ τὴν σύνεσιν ὁ ἐγκέφαλός ἐστιν ὁ διαγγέλλων.* It follows that the association, as old as Homer, of the *φρένες* and heart with *φρόνησις* is merely accidental. The *φρένες* have received their name *τῇ τύχῃ καὶ τῷ νόμῳ*. The author, who no doubt, remembers Alcmaeon's distinction between *αἴσθησις* and *φρόνησις*, admits that both heart and *φρένες* are sensitive (*ἡ καρδίη αἰσθάνεται ὅτι μάλιστα καὶ αἱ φρένες*), but adds *τῆς μέντοι φρονήσιος οὐδετέρῳ μέτεστιν, ἀλλὰ πάντων τούτων ὁ ἐγκέφαλος αἴτιός ἐστιν* (ib. 614). When we bear in mind the close connexion of Alcmaeon with the Pythagorean society and the evidence that Pythagoreanism itself started with the Milesian theories as a generally accurate account of the facts of the universe, it is difficult to resist the conviction that the two beliefs that the brain contains *ἀήρ* and that *ἀήρ* is *τὸ θεῖον* from the first had a great deal to do with the insistence on its central importance in the organism. Alcmaeon's dissections would confirm his theory; it is very unlikely that they originally suggested it.

The rival view was that the blood contains the vital heat of the organism and, in consequence, is also the seat of its intelligence. This is why Empedocles expressly says that it is the *περικάρδιον αἷμα* which is our *νόημα*, a theory clearly connected with the view that *τὸ θερμόν* is the 'divine' element. Views of this kind also are represented in some of the treatises which pass under the name of Hippocrates. Thus in the *περὶ ἑπταμήνου* (Kühn i. 490) it is maintained that the left ventricle of the heart is the residence of intelligence; *γνώμη γὰρ ἡ τοῦ ἀνθρώπου πέφυκεν ἐν τῇ λαιῇ κοιλίῃ* (sc. *τῆς καρδίης*) *καὶ ἄρχει τῆς ἄλλης ψυχῆς. τρέφεται δὲ οὔτε σιτίοισιν οὔτε ποτοῖσιν ἀπὸ τῆς νηδύος ἀλλὰ καθαρῇ καὶ φωτοειδεῖ περιουσίῃ γεγονυίῃ ἐκ τῆς διακρίσιος τοῦ αἵματος, εὐπορέει δὲ τὴν τροφὴν ἐκ τῆς ἔγγιστα δεξαμένης* (? *δεξαμενῆς*) *τοῦ αἵματος διαβάλλουσα* (l. *διαλαβοῦσα*) *τὰς ἀκτῖνας.* Similarly in *περὶ νόσων α'* (Kühn ii. 209) we read *τὸ αἷμα τὸ ἐν τῷ ἀνθρώπῳ πλεῖστον ξυμβάλλεται μέρος συνέσιος, ἔνιοι δὲ λέγουσι τὸ πᾶν.* This view would recommend itself not only to followers of

Empedocles but to the Heracliteans whom we know from Plato's own allusions to have been a well-organized sect in the fifth century, since it fits in with the view that it is *fire* which is the *θεῖον* in the universe. From the reappearance in 'Philolaus' (Fr. 13. R. P. 85) of the view that the *ἐγκέφαλος* is the *ἀρχή* of *νοῦς*, we may perhaps infer that Alcmaeon's theory, rather than that of Empedocles, was the accepted one in the Pythagorean society, so that T.'s adherence to it is strictly in keeping with his position as an eminent Pythagorean. Of course the theory of Alcmaeon could not be held by any one who combined the view that *τὸ θερμόν* is the divine element in things with the belief, also widely current, that the brain is *ψυχρόν*. (For the combination of the two views cf. e.g. the Hippocratean *περὶ ἀρχῶν*, or *σαρκῶν*, i. 425 *δοκέει δέ μοι ὃ καλέομεν θερμὸν ἀθάνατόν τε εἶναι καὶ νοεῖν πάντα καὶ ἀκούειν καὶ εἰδέναι πάντα καὶ τὰ ὄντα καὶ τὰ μέλλοντα ἔσεσθαι*, a conflation of Heraclitus with Anaxagoras; i. 427 *ὁ δὲ ἐγκέφαλός ἐστι μητρόπολις τοῦ ψυχροῦ καὶ τοῦ κολλώδεος*, whereas, according to this writer, i. 430, *πνεῦμα ἡ καρδίη ἕλκει θερμὴ ἐοῦσα μάλιστα τῶν ἐν τῷ ἀνθρώπῳ*. The last two sentences may explain why the author, though he avails himself of Alcmaeon's observations about the passages which connect the sense-organs with the brain, never speaks of the brain as playing any part in thought or as being the seat of the *ψυχή*.)

I think, then, that we can dimly detect two main divergent opinions about the seat of *ψυχή*, one which goes back to the conceptions of Anaximenes, regards *ἀήρ* as 'divine' and intelligent, and makes the brain the seat of *ψυχή*, originally, no doubt, because it was conceived as a sort of sponge holding air. The other, connected with the speculations of Heraclitus and Empedocles, regards *τὸ θερμόν* as the 'divine' and intelligent; and consequently leads to the conclusion that the *ψυχή* resides specially either in the blood generally or in the heart. From the *περὶ ἑπταμήνου* it would appear that the theory took the shape that the 'intelligence' is actually the *πνεῦμα* or 'animal spirits', which are regarded as an evaporation of the purest and finest substance of the blood. It is this view which we find reappearing in Aristotle and determining him to deny any connexion between the brain and intelligence. Aristotle knew that the brain itself is not sensitive, and hence drew the erroneous conclusion that it plays no important part in sensation, *de partibus Animal.* B. 656^{a} 23, *τῶν τ' αἰσθήσεων οὐκ αἴτιος οὐδεμιᾶς, ὅς γε ἀναίσθητος καὶ αὐτός ἐστιν ὥσπερ ὁτιοῦν τῶν περιττωμάτων*. (That is, the brain itself is no more sensitive than the hair or the nails.) He also accepted the view that the brain is 'cold', and on this ground denies that there is any anatomical connexion of the tongue with the brain, for the brain is cold and moist but the tongue hot (*de Sensu* 438^{b} 30), *τὸ δὲ γευστικὸν εἶδός τι ἁφῆς ἐστιν. καὶ διὰ τοῦτο πρὸς τῇ καρδίᾳ τὸ αἰσθητήριον αὐτῶν, τῆς τε γεύσεως καὶ τῆς ἁφῆς· ἀντικειται γὰρ τῷ ἐγεκφάλῳ αὕτη καὶ ἔστι θερμότατον τῶν μορίων*. (He allows the anatomical connexion for the organs of sight, hearing, and smell, but still maintains that in all these cases sensation depends on a further connexion of the peripheral sense-organ with the heart. This further connexion readily appears to him to be an established fact in consequence of the confusion of nerves with blood-vessels under the common name *πόροι*.) His special treatment of the brain itself is given *de partibus*

Animal. A. 7, 652ª 24 ff. He wrongly denies T.'s correct assertion that the brain is continuous with the *νωτιαῖος μυελός*, on the ground that this latter is hot, whereas the brain is the 'coldest part of the body'. He even denies that there is any blood in the brain ; it is, he says, *ἀναιμότατον τῶν ὑγρῶν τῶν ἐν τῷ σώματι*. It is, in fact, a compound of earth and water—the two cold 'elements'—and its use is simply to refrigerate the heart and blood, which would otherwise become over-heated, and so to preserve the balance or right mean in the temperature of the body (*εὔκρατον ποιεῖ τὴν ἐν τῇ καρδίᾳ θερμότητα καὶ ζέσιν*). The cold moisture of the brain acts on the evaporations from the blood, heated by food, as the cool air acts on hot vapours when it condenses them into clouds (loc. cit. 653ª 2 *δεῖ δὲ λαβεῖν, ὡς μεγάλῳ παρεικάζοντα μικρόν, ὁμοίως συμβαίνειν ὥσπερ τὴν τῶν ὑετῶν γένεσιν· ἀναθυμιωμένης γὰρ ἐκ τῆς γῆς τῆς ἀτμίδος καὶ φερομένης ὑπὸ τοῦ θερμοῦ πρὸς τὸν ἄνω τόπον, ὅταν ἐν τῷ ὑπὲρ τῆς γῆς γένηται ἀέρι ὄντι ψυχρῷ, συνίσταται πάλιν εἰς ὕδωρ διὰ τὴν ψύξιν καὶ ῥεῖ κάτω πρὸς τὴν γῆν*). That the brain is the origin (*ἀρχή*) of the nerves and the centre from which sensation and voluntary movement are initiated is argued at great length on the basis of actual dissection and experiments on living animals by Galen in *de Hippocratis et Platonis placitis* in opposition to the Stoic theory that the heart is the *ἀρχή* of all vital and psychical processes. Galen indicates as an important step towards a true doctrine the theory of Erasistratus (opening of third century B. C.) who finally satisfied himself that the nerves are connected with the brain, but at first held that they originate in the *dura mater* which encloses it. This view, Galen says, he only abandoned for the correct theory that they come from the substance of the brain itself (and, I suppose, of the *μυελός*) in his old age. (See op. cit. vii. 599–600, Kühn 602–3, for the words of E.'s express retractation on this point.) Galen's own theory is that the brain is the 'abode' (*οἴκησις*) of the *ψυχή*, the *πνεῦμα*, which he supposes to be contained in in the central ventricles, being only its immediate instrument (op. cit. vii. 602, Kühn 606 *βέλτιον οὖν ὑπολαβεῖν ἐν αὐτῷ μὲν τῷ σώματι τοῦ ἐγκεφάλου τὴν ψυχὴν οἰκεῖν, ἥτις ποτὲ ἂν ᾖ κατὰ τὴν οὐσίαν . . . τὸ πρῶτον δὲ αὐτῆς ὄργανον εἴς τε τὰς αἰσθήσεις ἁπάσας τοῦ ζῴου καὶ προσέτι τὰς καθ' ὁρμὴν κινήσεις τοῦτο εἶναι τὸ πνεῦμα*).

73 b 5–e 1. αὐτὸς δὲ ὁ μυελὸς . . . ὀστέινον. Construction of the spinal chord and the vertebral column which contains it. The spinal marrow is naturally said to be made from a selection of the smoothest and most accurately formed corpuscles of all the four 'roots'. This is the first hint we have been given that any of the corpuscles (or rather of the triangles which compose them, *τῶν τριγώνων*, 73 b 5) are not constructed with perfect precision. Hitherto we have heard of no differences other than a difference in size. Perhaps this is an inconsistency, but a Pythagorean could easily have got rid of it by laying any irregularities to the account of the intractable character of the element of *ἄπειρον* in things. Yet it does not fit in quite readily with the emphatic language in which T. has declared that the *πλανωμένη αἰτία* is always and everywhere completely subservient to the designs of *νοῦς*.

73 c 1. σύμμετρα. A 'tertiary' predicate, 'mingling them so as to be proportionate', 'mingling them in suitable proportions'. We are naturally not

told what the suitable proportions are. The actual law of the 'chemical composition' of μυελός T. does not profess to know, but he feels sure that, as the work is the work of God or νοῦς, there is such a law.

ib. **πανσπερμίαν.** The word is an old fifth-century one for a medley or 'concourse' of minute 'molecules' of different kinds. The picture it most readily suggests is the medley of the σπέρματα πάντων χρημάτων or σπερμάτων ἀπείρων πλῆθος assumed by Anaxagoras as the original state of things before νοῦς sets up the rotary movement which leads to the formation of a κόσμος. Aristotle uses the word with special reference to Anaxagoras, *de Generatione* A. 314ª 29, and also with reference to the atomism of Leucippus and Democritus, *Physics* Γ. 203ª 19 ὅσοι δ' ἄπειρα ποιοῦσι τὰ στοιχεῖα, καθάπερ Ἀναξαγόρας καὶ Δημόκριτος, ὁ μὲν ἐκ τῶν ὁμοιομερῶν, ὁ δ' ἐκ τῆς πανσπερμίας. As σπέρματα is not a very suitable name for the molecules of atomism, it looks most probable that the original application of the word was to those of Anaxagoras; possibly he used it himself. It would not be surprising if it were really older still, a genuine piece of early Pythagorean phraseology. This seems likely when we remember that Democritus, as we have seen, illustrated the behaviour of atoms in the δίνη by comparison with the passing of σπέρματα of different kinds through a sieve, an illustration also employed by Timaeus. The meaning here is simply that molecules of all the 'roots' are present in the μυελός, not that the μυελός alone supplies *all* the materials required for the construction of the rest of the body. This is not supposed to be the case.

73 c 5. τοσαῦτα καὶ τοιαῦτα διῃρεῖτο σχήματα. The accusatives are 'proleptic', 'divided the marrow into so many and such shapes' ὅσα οἷά τε ἔμελλεν αὖ σχήσειν. So below d 4 στρόγγυλα καὶ προμήκη διῃρεῖτο εἴδη, 'divided it into figures at once round and oblong'. (A.-H. says 'cylindrical', but that is perhaps too precise.) The subject of ἔμελλε σχήσειν is probably τὰ τῶν ψυχῶν γένη, as A.-H. assumes. Martin makes the μυελός itself the subject, but this is presumably an oversight. In any case the main point is that Timaeus wishes to indicate a difference between the shape assumed by the μυελός in the head, where the immortal element of the ψυχή resides, and in the vertebral column, which is the home of the θνητὸν εἶδος ψυχῆς. The γένη τῆς ψυχῆς are conceived as crops of different kinds of grain (φυτεύων c 3, ἄρουραν c 7) each of which requires to have the ground specially prepared to receive it. Hence the μυελός in which the θεῖον σπέρμα is to be sown must have a structure in virtue of which its mass is roughly spherical, so as to provide for the 'circles'; that of the θνητὸν εἶδος is elongated.

73 d 3. καθέξειν. Not simply to 'have' but to 'keep down', 'retain'. The verb is chosen to introduce appropriately the coming image of the soul as a vessel riding at anchor and kept in place by the chains and cables from which her anchors depend, the δεσμοί which have been alluded to already at b 4. For the metaphor we may perhaps compare St. Paul's ἐπιθυμία εἰς τὸ ἀναλῦσαι, if ἀναλῦσαι means there 'to slip the cable'.

73 d 4. μυελὸν δὲ πάντα ἐπεφήμισεν. That is, brain and spinal chord are one continuous substance. This continuity is recognized in the Hippocratean περὶ γονῆς (Kühn i. 371–2) οὕτω δὲ κἀν τῷ ἀνθρώπῳ

ἀποκρίνεται ἀπὸ τοῦ ὑγροῦ ἀφρέοντος τὸ ἰσχυρότατον καὶ τὸ πιότατον καὶ ἔρχεται εἰς τὸν νωτιαῖον μυελόν. The brain, it is added, supplies most of this ὑγρόν (ib. i. 373) χωρέει γὰρ τὸ πλεῖστον τοῦ γόνου ἀπὸ τῆς κεφαλῆς παρὰ τὰ οὔατα εἰς τὸν νωτιαῖον μυελόν. So περὶ ἀρχῶν (or σαρκῶν), Kühn i. 428 καὶ ὁ μυελὸς ὁ καλεόμενος νωτιαῖος καθήκει ἀπὸ τοῦ ἐγκεφάλου. (The more accurate way to put it would be that the brain is an outgrowth of the cord.) It is curious that Aristotle should have denied the continuity. He is aware himself that he is running counter to the general medical opinion on the point (*de partibus Animal.* B. 652ᵃ 24 πολλοῖς γὰρ καὶ ὁ ἐγκέφαλος δοκεῖ μυελὸς εἶναι καὶ ἀρχὴ τοῦ μυελοῦ διὰ τὸ συνεχῆ τὸν ῥαχίτην αὐτῷ ὁρᾶν μυελόν). He will, however, admit nothing more than a contiguity of position between the two; the substantial character of the one is the 'exact antithesis' of that of the other (loc. cit. 652ᵃ 27 ἔστι δὲ πᾶν τοὐναντίον αὐτῷ τὴν φύσιν ὡς εἰπεῖν· ὁ μὲν γὰρ ἐγκέφαλος ψυχρότατον τῶν ἐν τῷ σώματι μορίων, ὁ δὲ μυελὸς θερμὸς τὴν φύσιν). In fact, he holds, the very reason why the two are *spatially* continuous is that this juxtaposition of opposites effects organic equilibration (loc. cit. 652ᵃ 31 ἀεὶ γὰρ ἡ φύσις μηχανᾶται πρὸς τὴν ἑκάστου ὑπερβολὴν βοήθειαν τὴν τοῦ ἐναντίου παρεδρίαν, ἵνα ἀνισάζῃ τὴν θατέρου ὑπερβολὴν θάτερον). Aristotle is so wedded to the metaphysical conception of the construction of φύσις out of elementary 'opposites' that he cannot fairly estimate the evidence of observed facts which are difficult to fit in with the theory.

73 d 7. περὶ ὅλον. The reading of all the MSS. gives precisely the right sense, 'a bony covering round it as a whole'. The αὐτῷ for which the covering was devised refers, like τοῦτο in d 6, to the μυελός, the brain and spinal chord. Valckenaer's conjecture περίβολον, 'a bony covering as a fence' or 'a covering consisting in a bony fence', strikes me as singularly inopportune. The comparison with the stone wall in 74 a would really be spoiled by supposing that it had been already anticipated here.

In the section which follows on the composition of the different tissues of the human body Timaeus is treating a question which had been brought to the front in the middle of the fifth century, when biological and medical studies came to replace astronomy and cosmology as matters of primary interest. Speculative biologists like Empedocles attempted to explain the physiology of the human body *a priori* on the strength of their general postulates about the number and kinds of the primary bodies in the universe. More practical medical men objected in principle to this attempt to base physiology and medicine upon cosmological theory, insisting that the study of medicine should have no foundation but carefully ascertained empirical fact. This is why we find some of the works of the Hippocratean collection starting from unproved cosmological postulates (e. g. the περὶ φυσῶν, the περὶ διαίτης α΄), while others, like the well-known περὶ ἀρχαίης ἰητρικῆς, vehemently denounce those who build on the improved ὑποθέσεις of σοφισταί (that is, on the speculative assumptions of the cosmologists), as corrupting their τέχνη, and still others are made up wholly of careful records of observed cases and contain no reference at all to general theory. The περὶ ἀρχαίης ἰητρικῆς is particularly instruc-

tive. The date of the work seems to be fixed pretty clearly by two considerations. On the one hand it cannot be much earlier than the middle of the fifth century as it treats the Empedoclean doctrine of the four 'roots' as the latest and favourite cosmological speculation. On the other hand, the cosmologists are spoken of simply as *σοφισταί*, and it may fairly be argued that this means that the name has not yet become in any way specially appropriated to the imitators of Protagoras, who made a trade of 'educating men'. Thus we reach an approximate date for the composition of the little work. The theory of Empedocles is already famous; on the other hand there is no trace of the scepticism about science which was so characteristic of the time of the Archidamian war. The 'relativity' formula of Protagoras has at any rate not yet made enough headway for our writer to take account of it, though if it had been widely accepted it would have affected his contention that medicine is a surely established *τέχνη* in the gravest possible way. The author's thesis is that the 'old' medicine is a genuine science securely founded on careful observation of facts, and that the 'new-fangled' speculators are robbing it of its scientific character. The essay opens as follows (§§ 1–2). 'Those who have undertaken to speak or write about medicine starting with the (arbitrary) postulation of hot or cold, moist or dry, or what they please (*ὑπόθεσιν αὐτοὶ αὐτοῖς ὑποθέμενοι τῷ λόγῳ θερμὸν ἢ ψυχρὸν ἢ ὑγρὸν ἢ ξηρὸν ἢ ἄλλο τι ὅ ἄν θέλωσιν*), and so simplifying the cause of disease and death in man and making it the same in all cases, postulating one thing or two things, are obviously in fault in many of the novel things they say, but deserve especial reprobation because they behave thus about a well-established science (*ἀμφὶ ἐούσης τέχνης*), which all men employ in matters of the first concern, giving the highest honour to sound craftsmen and practitioners (*ἣ χρέονταί τε πάντες ἐπὶ τοῖσι μεγίστοισι καὶ τιμῶσι μάλιστα τοὺς ἀγαθοὺς χειροτέχνας καὶ δημιουργούς*). Some practitioners are inferior and others much superior. This would not be so if the science of medicine were non-existent and all men were equally unskilled and unscientific about it; all treatment of the sick would be a matter of luck. But the actual case is otherwise; as in other sciences practitioners (*οἱ δημιουργοί*) differ widely in manual dexterity and in judgement (*κατὰ χεῖρα καὶ κατὰ γνώμην*), so it is in medicine. So my own conviction is that medicine does not require any novel postulate (*καινῆς ὑποθέσεως*) as obscure and disputed matters do. If one attempts to treat of the latter, for example, of the things on high or under the earth (a clear allusion to Empedocles' interest in volcanoes and hot springs), one is obliged to employ a postulate (*ἀνάγκη ὑποθέσει χρῆσθαι*); if one states this, and recognizes the state of the case, it is clear neither to the speaker nor to his hearers whether his assumptions are true or not, as there is no standard by reference to which certainty (*τὸ σαφές*) can be attained. But medicine has long been provided with an established starting-point and an ascertained method (*ἰητρικῇ δὲ πάλαι πάντα ὑπάρχει, καὶ ἀρχὴ καὶ ὁδὸς εὑρημένη*), by following which many admirable discoveries have been made in the course of time, and others will be made if the inquirer is capable and knows what has already been discovered and makes that the starting-point for his own researches.' At § 13 the

writer proceeds to make a more particular attack on the 'new medicine' for its use of the theory, which goes back to Alcmaeon's doctrine of health as *ἰσονομίη*, that all cures should be based on the principle of correcting the excess of one 'humour' (*ὑγρόν*) in the body by its 'opposite'. 'Take a man of comparatively delicate constitution (*ἔστω μοι ἄνθρωπος μὴ τῶν ἰσχυρῶν φύσει, ἀλλὰ τῶν ἀσθενεστέρων*). Let him eat wheat picked up from the floor of the barn, uncooked and unprepared, and raw meat and drink water. If he follows this regimen he will certainly suffer severely. He will feel pain, his body will grow weak, his digestion will be ruined, and he will not live long. What treatment should be given to a man in this state? Are we to treat him with the hot or with the cold or with the dry or with the moist? If it is one of them which causes his illness, the proper thing, according to their doctrine, is to cure it by its opposite. Now the surest and most obvious treatment is to stop the man's former regimen, to give him bread instead of wheat and cooked meat instead of raw, and wine to drink. The change is sure to make him well if he has not been completely ruined by persistence in his regimen. Now what are we to say? Has the man been cured of a disorder due to the cold by treating him with the hot, or the opposite? I fancy the question will not be easy to answer. Did the man who prepared the bread take out of the wheat the hot or the cold or the dry or the moist? For the bread has been treated by both fire and water, and worked up with other materials, each of which has its own quality and character, and so has lost some of its properties and been blended with others.' That the particular *ὑπόθεσις* attacked is that of Empedocles and the Sicilian school is shown by the selection of just four ultimates, the hot, the cold, the moist, the dry, for the purpose of the polemic. Later on (§ 20) Empedocles is expressly singled out by name for censure. 'Some physicians and sophists say that no one can know medicine unless he knows what man is and how he was produced at first and from what constituents he was originally compounded (*ὅ τί ἐστιν ἄνθρωπος καὶ ὅπως ἐγένετο πρῶτον καὶ ὁπόθεν συνεπάγη ἐξ ἀρχῆς*). A man who is going to treat human patients properly, they think, must learn all this. Their argument makes towards philosophy (*τείνει ἐς φιλοσοφίην*), after the fashion of Empedocles and the other writers about *φύσις* (*καθάπερ Ἐμπεδοκλῆς ἢ ἄλλοι οἳ περὶ φύσιος γεγράφασιν*). *My* view is that though what some physician or sophist may have said or written about *φύσις* belongs less to medicine than to literature (*ἧσσον τῇ ἰητρικῇ τέχνῃ προσήκειν ἢ τῇ γραφικῇ*), it is only from medicine itself that anything certain can be learned about *φύσις*' (*περὶ φύσιος γνῶναί τι σαφὲς οὐδαμόθεν ἄλλοθεν εἶναι ἢ ἐξ ἰητρικῆς*). Of course it was important that medicine should be made independent of unprovable speculations about cosmology, and it seems to have been the great merit of the school of Cos to insist on this independence. But there was clearly a strong opposition to this empiricism among the medical men themselves, and this explains the presence in the so-called *opera Hippocratis* of works like the *περὶ φυσῶν*, *περὶ διαίτης α'*, *περὶ ἀρχῶν* (or *σαρκῶν*), and others in which the speculations of the cosmological *σοφισταί* are recklessly adopted. The most eminent fifth-century representative of speculative biology was Empedocles

himself. Diogones of Apollonia is another example, though he reverted to the crude monism of Anaximenes, and simply grafted on the ἀήρ of that philosopher all the characteristics of the νοῦς of Anaxagoras. In the fourth century Aristotle definitely preferred to base medicine on a speculative general theory. As he puts it (*de Sensu* 436ª 19), most students of natural science include medical topics in their course of study, and 'the more scientific practitioners' start from 'physics' (διὸ σχεδὸν τῶν περὶ φύσεως οἱ πλεῖστοι καὶ τῶν ἰατρῶν οἱ φιλοσοφωτέρως τὴν τέχνην μετιόντες, οἱ μὲν τελευτῶσιν εἰς τὰ περὶ ἰατρικῆς, οἱ δ' ἐκ τῶν περὶ φύσεως ἄρχονται περὶ τῆς ἰατρικῆς). The same statement is made more fully at the end of the *Parva Naturalia* (480ᵇ 22) περὶ δὲ ὑγιείας καὶ νόσου οὐ μόνον ἐστὶν ἰατροῦ ἀλλὰ καὶ τοῦ φυσικοῦ μέχρι τοῦ τὰς αἰτίας εἰπεῖν. ᾗ δὲ διαφέρουσι καὶ ᾗ διαφέροντα θεωροῦσιν, οὐ δεῖ λανθάνειν, ἐπεὶ ὅτι γε σύνορος ἡ πραγματεία μέχρι τινός ἐστι, μαρτυρεῖ τὸ γινόμενον· τῶν τε γὰρ ἰατρῶν ὅσοι κομψοὶ ἢ περίεργοι, λέγουσί τι περὶ φύσεως καὶ τὰς ἀρχὰς ἐκεῖθεν ἀξιοῦσι λαμβάνειν, καὶ τῶν περὶ φύσεως πραγματευθέντων οἱ χαριέστατοι σχεδὸν τελευτῶσιν εἰς τὰς ἀρχὰς τὰς ἰατρικάς. Cf. the praise bestowed in our dialogue (24 b 7) by the imaginary Egyptian priest on the Egyptian treatment of ἰατρική and μαντική. If Aristotle's caution that the points of difference between φυσική and ἰατρική must not be overlooked is borne in mind, his contention only amounts to the sound one that a really scientific biology is the foundation of medicine. In the account of the various tissues Timaeus is following Empedocles in explaining that bones, etc., are compounds of the 'roots' in different proportions. We still possess E.'s formula for the composition of bone (Fr. 96, R. P. 175), 'kindly earth received in her broad funnels two parts out of the eight of shining Nestis [i. e. water], and four of Hephaestus [fire], and they became white bones'. From Aristotle's remarks at *Met.* A. 993ª 17 ff., where he urges that if there is an exact formula for the composition of bone, there *ought* also to be similar formulae for 'flesh and the rest', it would appear that bone was the only case in which E. had attempted to give the actual precise formula. He was, however, evidently satisfied that there are such formulae for other cases, since he says (Fr. 98, R. P. 175 e) that blood and flesh contain all four 'roots' in equal or nearly equal quantities. He seems to have illustrated these theories by similes drawn from the crafts, such as the heating of baths and the baking of bread in ovens. Timaeus is adopting this conception of the various tissues as compounds with characteristic formulae and developing it.

73 e 1—74 a 7. τὸ δὲ ὀστοῦν . . . κάμψεως ἕνεκα. T.'s account of bone, then, is that it is a composite of spinal marrow and carefully sifted and refined earth which has been repeatedly hardened by fire and then cooled by plunging it into water. This last point is clearly meant to account for the brittleness of the bones. Thus he apparently differs from Empedocles in making earth, not fire, the preponderant constituent. Air comes in as already contained in the μυελός, earth is added as a fresh ingredient, over and above the earth in the μυελός, and the agency of both fire and water is invoked.

73 e 1–2. διαττήσας . . . ἐφύρασε. The 'sifting' and 'kneading' are processes employed in baking bread. We see from Fr. 34, ἄλφιτον ὕδατι

κολλήσας (quoted by Aristotle, *Meteor.* A. 382ª 1), that Empedocles also had used the illustration of the baker in some unspecified context. It looks as though the words may have belonged to the passage about the making of bones. T. may well be following Empedocles in introducing the thought at this point.

73 e 3. αὐτό. The 'it' is the composite formed by the earth which has been thoroughly soaked with μυελός.

73 e 5. ὑπ' ἀμφοῖν ἄτηκτον, since bones can neither be wholly melted nor completely consumed by fire.

73 e 6—74 a 3. καταχρώμενος . . . κύτους. Bone being thus made, the next step was to make a spherical case of it for the brain and a series of vertebrae extending right down the neck and back to hold the spinal cord. νωτιαῖος μυελός is the regular physiological and medical technical term for the *medulla spinalis*.

73 e 6–7. αὐτοῦ . . . ταύτῃ. A.-H. regards αὐτοῦ as a genitive of the material with σφαῖραν, 'a sphere of it', and ταύτῃ as an adverb, translating 'on one side'. It seems to me that ταύτῃ is the pronoun, 'but left a narrow outlet for it' (the σφαῖρα). Should not 'on one side' be τῇδε or τῇ, not ταύτῃ? If αὐτοῦ is gen. of material with σφαῖραν its emphatic position in the clause is unusual. Could we not take it as the adverb, 'on the spot', *daselbst*, in close connexion with περὶ μὲν τὸν ἐγκέφαλον?

74 a 2. σφονδύλους . . . οἷον στροφίγγας. The first word refers to the shape of the vertebrae, the second to their function. σφόνδυλος, Ionic σπόνδυλος, is the standing technical name for a vertebra. L. and S. treat the other sense, familiar to us from the myth of Er, 'the round weight which twirls and balances a spindle' as derived from this because of the resemblance in shape. I should have thought it more probable that the σφόνδυλοι of the spinal column were called so from their resemblance to the familiar household object, just as the anatomical meanings of κλείς, κτείς, μῦς, etc., are derivative; στρόφιγγες are properly 'pivots', in particular, the pivots at the top and bottom on which a door turns. The word was sufficiently unusual in common literature to be glossed in the *Lexicon* of Timaeus, στρόφιγγες· οἱ τῶν θυρῶν στροφεῖς. Cf. Hamlet's 'pregnant hinges of the knee'.

74 a 4. καὶ τὸ πᾶν δὴ σπέρμα. The marrow is called σπέρμα here simply because it is the 'seed' from which the rest of the body is produced. Cf. πανσπερμίαν παντὶ θνητῷ γένει μηχανώμενος *supra* 73 c 1. There is no allusion to the physiological theory, which we do not meet until 91 b, that the *semen genitale* is a distillation from the μυελός.

74 a 5–6. τῇ θατέρου προσχρώμενος . . . δυνάμει. A difficult phrase which has given the editors a good deal of trouble. What is that 'quality of the others' or 'quality of otherness' which God availed Himself of in articulating the vertebral column? St. supposed θάτερον to mean 'unformed matter' (it would be better if he had said simply 'the ἄπειρον'). But T. has left no place for matter which is not figured by his elementary triangles in his theory. M. suggested that the reference is to the synovial fluid which lubricates the vertebrae, but there is nothing to show that T. knows of the existence of this fluid, and he could not expect to be understood in alluding to it so obscurely. A.-H.'s guess that θάτερον

means plurality and that T. is only saying that the vertebral column was made of many *σφόνδυλοι* because it would not have been flexible if it had been all in one piece, seems no better. He might, perhaps, have made his case more plausible if he had suggested that T. wishes to correct the curious theory of Empedocles that the spinal column was at first a single bone until an animal broke its back by trying to turn round, and that the 'variation', being 'useful', survived. (Aristot. *de partibus Animal.* A. 640ª 19 ff.) I think T. really has this in mind when he is careful to say that the actual structure of the spinal column is not a consequence of accident but was planned by God from the beginning for a purpose. But this leaves the expression about the *θατέρου δύναμις* still unexplained. C. W. seems to have hit on the right method of interpreting the phrase when he quotes (*On the interpretation of Plato's* Timaeus, p. 67) the important Aristotelian passage (*de Anima* Γ. 433ᵇ 21 ff., where Aristotle says, speaking of a bone turning in its socket, that the concave surface is at rest but the convex is moving', the two surfaces being *λόγῳ ἕτερα μεγέθει δ' ἀχώριστα*, 'logically distinguishable but locally inseparable') *τὸ κωοῖν ὀργανικῶς ὅπου ἀρχὴ καὶ τελευτὴ τὸ αὐτό, οἷον ὁ γιγγλυμός. ἐνταῦθα γὰρ τὸ κυρτὸν καὶ κοῖλον τὸ μὲν τελευτὴ τὸ δ' ἀρχή· διὸ τὸ μὲν ἠρεμεῖ τὸ δὲ κινεῖται, λόγῳ μὲν ἕτερα ὄντα, μεγέθει δ' ἀχώριστα, κτλ.* If we follow up this hint, we are led to consider two or three further passages in Aristotle. One is *de motu Animalium* 698ª 16 (quoted to illustrate the sentence of the *de Anima* by Trendelenburg); 'if one part of an animal's body moves, some other part must be at rest. This is why animals have joints (*καμπαί*). The joints are used as pivots, and the whole member in which the joint is becomes both one and two, straight and bent, changing potentially and actually in virtue of the joint.... And the origin of the movement, as such, always remains at rest when the lower part of the limb is moved' (*δεῖ γάρ, ἂν κινῆταί τι τῶν μορίων, ἠρεμεῖν τι· καὶ διὰ τοῦτο αἱ καμπαὶ τοῖς ζῴοις εἰσίν. ὥσπερ γὰρ κέντρῳ χρῶνται ταῖς καμπαῖς, καὶ γίνεται τὸ ὅλον μέρος, ἐν ᾧ ἡ καμπή, καὶ ἓν καὶ δύο, καὶ εὐθὺ καὶ κεκαμμένον, μεταβάλλον δυνάμει καὶ ἐνεργείᾳ διὰ τὴν καμπήν. . . . ἀλλ' οὖν ἀεὶ ἡ ἀρχὴ, ᾗ ἀρχή, ἠρεμεῖ κινουμένου τοῦ μορίου τοῦ κάτωθεν.*) Cf. ib. 702ª 22 *ἡ δὲ καμπὴ ὅτι μέν ἐστι τοῦ μὲν ἀρχὴ τοῦ δὲ τελευτή, εἴρηται.* Still more to the purpose, perhaps, is the passage *de partibus Animal.* B. 654ª 25–ᵇ 28, especially the words, 654ᵇ 14, 'since it is necessary that the animal's body shall bend in locomotion, the spine, while it is one in virtue of the continuity of its parts, yet by its division into vertebrae is made to consist of many segments (*ἐπεὶ δ' ἀνάγκη κινουμένου τοῦ ζῴου κάμπτεσθαι τὸ σῶμα, μία μὲν διὰ τὴν συνέχειάν ἐστι*,—sc. *ἡ ῥάχις*—*πολυμερὴς δὲ τῇ διαιρέσει τῶν σπονδύλων*). Cf. 654ª 35 where we are told that the bones have been connected *ἵνα χρῆται ἡ φύσις καὶ ὡς ἑνὶ καὶ συνεχεῖ καὶ ὡς δυσὶ καὶ διῃρημένοις πρὸς τὴν κάμψιν*, 'that nature may use adjoining bones either as though they were one continuous bone or, for purposes of flexure, as though they were two and distinct'. These passages, especially the last, seem to give us the clue to T.'s meaning. If he regards the two surfaces of an articulation, the concave and the convex, as in complete contact throughout, as Aristotle did, this would explain what is meant by the 'quality of the other'. We can distinguish logically between the two, and so far

each is 'other' than the other; but there is nothing between them; they are physically inseparable, and in that sense they are one. Until some one can suggest a better interpretation, I think this should be accepted. For an anatomical description of the spine and its vertebrae from the golden age of Greek medical science cf. Hippocrates *περὶ ἄρθρων ἐμβολῆς* 45 (ed. Kühlewein ii. 171–3). The words *ὡς μέσῃ ἐνισταμένῃ* seem to me to be in favour of the view which, following C. W., I have taken of the passage. The common surface where one vertebra turns on another is something which, belonging as much to the one as to the other, may be called an 'intermediate' term.

74 a 7–c 5. τὴν δ' αὖ . . . ἀμυνεῖσθαι μετρίως. Next the bones themselves demanded a further covering. A mere bony skeleton enveloping *μυελός* would have had three defects. It would have been at once too brittle and too little flexible, and would have been exposed to injury from sudden variations of temperature. The *νεῦρα* provide a remedy for the second of these deficiencies, and the covering of flesh secures us against the other two, as it keeps the bones and their contents at an equable temperature and also serves to break the force of blows and falls. The *νεῦρα* are not 'nerves'—if T. knew of the existence of these they are covered by his references to *φλέβια* and *πόροι*—but sinews and tendons (the regular classical sense of *νεῦρα*). The theory, then, makes flesh, sinew, &c., to exist, in the end, simply as a protection for the bony skeleton, which is, next to the all-important *μυελός*, the essential part of the body. Aristotle is presumably protesting against this passage when he says (*de partibus Animal.* B. 653^{b} 21) 'flesh forms the very basis of animals and is *the* essential constituent of their bodies. This follows from the very definition of animal. For an animal is by definition something which has sensibility and primarily the fundamental sense, that of touch, and it is the flesh or its analogue which is the organ of this sense . . . It is obvious also to sense that it is for the sake of the flesh that all the other parts exist . . . Thus, the bones are a contrivance to give security to the soft part of the body' (*τοῦτο γὰρ*—viz. *σάρξ* or its equivalent—*ἀρχὴ καὶ σῶμα καθ' αὐτὸ τῶν ζῴων ἐστίν. δῆλον δὲ καὶ κατὰ τὸν λόγον. τὸ γὰρ ζῷον ὁριζόμεθα τῷ ἔχειν αἴσθησιν, πρῶτον δὲ τὴν πρώτην· αὕτη δ' ἐστὶν ἁφή . . . κατὰ δὲ τὴν αἴσθησιν φανερὸν πάντα τἆλλα τούτου χάριν ὄντα . . . ἡ μὲν γὰρ τῶν ὀστῶν φύσις σωτηρίας ἕνεκεν μεμηχάνηται μαλακοῦ*).

74 b 1. κραυροτέραν. Not 'too rigid' (A.-H.) but 'too brittle', and therefore liable to injury by the 'falls' referred to below. The repeated hot and cold baths to which bones were subjected in making explain this point.

74 b 2. σφακελίσασαν. *σφάκελος* in the medical writers is the term used to describe both caries in the bones and gangrene in the flesh. A substance like bone, if exposed directly to sudden and great variations of temperature, would be apt to split or splinter with disastrous consequences to the *μυελός* contained in it.

74 b 5–6. περὶ τοὺς στρόφιγγας. M. and A.-H. take the words with *ἐπιτεινομένῳ καὶ ἀνιεμένῳ*. This seems to me probably mistaken. It is not very natural to speak of the *νεῦρα* as being 'stretched and relaxed

round' pivots, especially when we remember that στρόφιγγες must mean here, as at 74 a 2, the vertebrae. I should propose to connect the words with καμπτόμενον, 'that he might make the body capable of extension in virtue of their tension and relaxation, and flexible about its pivots'. The vertebrae are the 'pivots' of the body as a whole, not of the νεῦρα in particular.

74 b 7. προβολὴν . . . πρόβλημα. A.-H. remarks that the 'juxtaposition of two closely cognate forms' without difference in sense is unusual in Plato in a case of this kind, and suggests that πρόβλημα, the more usual of the two, has extruded προβολήν from the text in the second clause. I should rather suspect that since the use of such crude rhetorical devices is, in Plato, always tinged with a slight touch of mockery, he is actually parodying fifth-century 'ornate' style. More suspicious, to my mind, is the curious use of κτήματα in the next line for 'garments'. When κτήματα means anything more definite than 'belongings' in general, it most commonly means 'live stock', 'flocks and herds'. If there were any record of variants in the MSS., I should be inclined to wonder if ἔσεσθαι κτήματα could be a corruption of ἐσθήματα. (A 'felted' cuirass or cloak, for instance.)

74 c 1–2. θερμὴν νοτίδα. This is sweat, which is regarded as helping to keep the internal temperature cool in summer and also warm in winter.

ἀνιδίουσαν. Unless this was the original reading of A, we have another of the very few examples in the dialogue of a universal corruption older than all our existing MSS. This is to be explained by the extreme rarity of the verb.

74 c 3. ψῦχος οἰκεῖον. A coolness *of its own*, provided by its internal resources, as opposed to the coolness imparted to a body by e.g. the surrounding air.

74 c 4. τούτῳ τῷ πυρί. All warm liquids, according to the analysis of 59 d, contain an admixture of fire. (Cf. the account of 'tears' at 68 a.) This is why T. speaks here of 'this' fire, with a tacit antithesis to the fire on the hearth. The thought is that sweat keeps us cool in summer because it contains moisture and warm in winter because it contains fire. The future infinitives, ἔσεσθαι, παρέξειν, ἀμυνεῖσθαι, are merely 'epexegetic' after ἐμηχανᾶτο. God devised the flesh 'for being a defence', for providing coolness in summer, for keeping out the frost in winter. The future tense is used because we are talking of the use which would *hereafter*—when the ψυχαί now resting in the bosoms of the ὄργανα χρόνων should emerge—be made of all these arrangements. For this we may compare similar constructions in Thucydides, e.g. Thuc. vii. 56 οἱ Συρακόσιοι . . . τὸ στόμα αὐτοῦ διενοοῦντο κλῄσειν, the S. purposed *by and by* to close the entrance to the harbour. It is wrong to say with A.-H. that we must 'understand' διενόηθη or a similar word. The future infinitive is no more usual after διανοεῖσθαι than after μηχανᾶσθαι (Madvig *Gk. Syntax* § 171). With μηχανᾶσθαι it is usual to find a ὅπως clause, but for an example of the infinitive cf. Plato *Rep.* vii. 519 e 3 ἐν ὅλῃ τῇ πόλει τοῦτο μηχανᾶται ἐγγενέσθαι.

74 c 5–e 1. ταῦτα ἡμῶν . . . ἄνωθεν. Accordingly God made flesh and

then constructed the *νεῦρα* out of this and bones, wrapped the bones and *μυελός* round with the *νεῦρα*, and finally enclosed the whole with flesh.

74 c 6. ὕδατι μὲν καὶ πυρὶ καὶ γῇ. Does T. mean to say that there is no 'air' in *σάρξ*? This would be a divergence from Empedocles (Fr. 98), and I think we shall find that T. himself implies, in his account of diseases, that there is air in flesh. There is no real oversight. We must remember that we have already been told that *μυελός* enters into the composition of all the tissues, and *μυελός* itself contains all the 'roots'. In fact, the unexpressed direct object of *συμμείξας* and *συναρμόσας* is *μυελόν*. We can only infer then that presumably there is more of the other three 'roots' in *σάρξ* than there is of air.

74 d 1. ζύμωμα. The presence of this 'ferment' or 'leaven' of 'something acid or briny' would, I suppose, be inferred from the taste of the secretions of the skin? The words *ζύμωμα* and *ἀζύμου* below are reminiscent of Empedocles' simile of the baker. The meaning of the passage seems to me to have been generally misapprehended by the commentators in consequence of an error of text. The earlier editions have a *καί* before *ὑπομείξας*, which seems to rest on no good MSS. authority, and has consequently disappeared from the Tauchnitz text of St. and from those of Hermann, the Zürich editors, Bt., Riv., though it is retained in St.'s original edition of the *Timaeus* and in those of Martin and A.-H. The insertion of the *καί* (which is represented also in the Latin version of Ficinus) requires us to regard the fire, water, and earth which are mixed with the *μυελός* and the *ζύμωμα* of the 'acid and the briny' as two distinct ingredients in the composition of *σάρξ*, as St. (in his commentary), Martin, and A.-H. do. But it seems to me that they must really be the *same* thing. We have already learned that 'acids' are bubbles of water containing earth (66 b 4), and that salt is a refined earth (60 e). Hence I conceive that the 'earth, water, and fire' *are* the *ζύμωμα* or 'leaven' which God adds to the *μυελός* in making flesh, in order that it may 'rise'. In syntax, I take it, the *ὑπομείξας* is subordinate to the *συνθείς*, and the *συνθείς* subordinate to *συμμείξας* and *συναρμόσας*. I would translate, 'he made a mixture and composition with earth and fire and water, composing a ferment of acid and briny by making a mixture with these materials (*αὐτοῖς* = *τῷ ὀξεῖ καὶ τῷ ἁλμυρῷ*)'. As I understand T., the *μυελός* is the flour, the added earth, fire, and water the yeast, from which God makes His loaf. Martin makes the slip of rendering *ὀξέος* by *vinaigre*. But the word for vinegar is *ὄξος*, of which the genitive in Attic would be *ὄξους*.

74 d 2–3. σαρκὸς ἀζύμου. I do not think this expression affects the interpretation of the preceding words. A very slight difference in the proportion of the ingredients or even mere neglect to leave sufficient time for the fermentation would produce something which could be called *ἄζυμος σάρξ*.

74 d 3–4. μίαν ἐξ ἀμφοῖν . . . προσχρώμενος. See the passage quoted in A.-H. from Hippocrates *περὶ τόπων τῶν κατ' ἄνθρωπον* (Kühn ii. 107) where it is similarly said that *νεῦρα*, sinews, and tendons, are nourished partly from the bones and partly from the flesh, with the result that they are moister and more 'fleshy' than bone, but drier and more 'bony'

than flesh. This explains why in the order of creation T. puts them after both ὀστᾶ and σάρξ.

74 e 1. ἐμψυχότατα. These will be the bones of the skull and vertebral column. It is to be explained why the head and the back are not fleshy. A great mass of flesh surrounding a bone might either (1) interfere with sensitivity and make the mind dull, or (2) make movement difficult. T. explains the absence of flesh from the neighbourhood of skull and spine by the first consideration, its absence at the joints by the second.

74 e 8. ἀναισθησίαν ἐμποιοῦσαι. It is no objection to say that the flesh of the thigh, for example, is 'acutely sensitive'. The criticism confounds sensibility to pain with delicate tactual discrimination. It is quite true that the fleshy parts of the body, or to speak more accurately, the skin which covers them, is wanting in this respect, as will be found explained in the various manuals of Psychology. If, for example, we compare the delicacy of localization in different regions of the skin, the most sensitive regions are the lips, the tongue, the temples, the inner surface of the forearm, &c., none of them among the fleshy parts of which T. is speaking. The thigh comes very low down in the list. As T. is dealing here with sensations solely as instrumental to cognition of objects, it is nothing to his purpose that the parts of which he speaks as 'insensitive' give rise to keenly apprehended pain. Similarly with respect to the discrimination of size and shape by touch; contact of a surface with the skin of the thigh reveals much less of the size and shape of the surface than contact with the palm of the hand, which is not 'fleshy'.

75 a 3. ἐν μυελῷ. A.-H. thinks that Plato is (rightly) distinguishing between the substance of the spinal cord and what we popularly call the 'marrow' in the bones, and that he confines the name μυελός to the former. To me the language seems rather to prove that Plato draws no such distinction, but regards the bones as containing some small portion of the very μυελός of which the brain and spinal cord are made. It is not said that there is no ψυχή in them, but only that there is not much. The distinction was clearly made by the writer of the Hippocratean περὶ σακρῶν (or ἀρχῶν) who (Kühn i. 428) objects to giving the name μυελός to the spinal cord on the ground that, unlike μυελός properly so-called, it does not contain much of τὸ λιπαρὸν καὶ τὸ κολλῶδες. It is curious that though Aristotle denied that the brain consists of 'marrow', he still regarded the spinal cord as being formed of this substance, and, in fact, made this his reason for denying the continuity, in a biological sense, of the brain with the cord. See *de partibus Animal.* B. 7, 652ᵃ 25 ff. and the preceding chapter B. 6 on μυελός.

75 a 7. ἐκείνως. Strict grammar would require us to supply as the verb here συμπεπλήρωται σαρξίν, as with the ἧττον of l. 4. But we should do better, with regard to the sense, to treat the sentence as slightly 'anacoluthic' and to understand with ἐκείνως a word like ἔχει or μεμηχάνηται. The meaning of the following words about the ἐξ ἀνάγκης γιγνομένη καὶ συντρεφομένη φύσις seems to be that we must just accept it as an unexplained fact, one of those which together make up ἀνάγκη, that fleshiness and acute sensibility do not go together. The example of the tongue, just given, shows that there is no apparent reason why

a fleshy organ might not have finely discriminative abilities, but we do find it as a 'coincidence' that where there is a great quantity of flesh over a thick bone the 'threshold', both the sensation-threshold and the difference-threshold, is high. There is, no doubt, some good reason for this, but we cannot say what the reason is. This point is then humorously illustrated further. We might have thought it desirable that the brain, the palace of the *θεῖον* in the *ψυχή*, should be secured against injury by being enclosed in a stout covering of bone with plenty of flesh around it. If we had crania like those of the elephant or rhinoceros, we might be immune from many dangers to the brain, and still more so if these skulls had flesh round them. There would not be many cases of concussion or fractured skull. (In the *πόλεις* of the fifth century the men of science had to take their share in service in the field, and wounds in the head or fractures of the skull would be among the commonest dangers to which combatants would be exposed. This explains why T. dwells on the thought of these risks, as it explains why *τὰ ἐν κεφαλῇ τρώματα* are the subject of such careful treatment in the Hippocratean work which deals with them. The curing of them would be one of the commonest duties of the *ἰατρός*.) We might thus have lived longer and in much more comfort and health. But, for some reason, the combination of keen perception and intelligence and a 'thick head' is impracticable, and therefore it is *better* to have a short life as a being of high intelligence than to last out through centuries of the dullness of a gigantic rhinoceros. Hence our makers preferred quality of life to quantity for us.

There is a real and permanent point in these remarks, which is independent of T.'s apparent assumption that the brain itself is sensitive. We may illustrate his meaning by the extreme sensibility to injury of such an organ as the eye. The fineness and complexity of structure necessary if the organ is to be highly discriminative demand that it should be liable to the risk of being easily thrown out of gear. Yet it is better to have a human eye, with all its susceptibility to pain and disease, than to have a less easily deranged organ which would only respond to light and colour clumsily and crudely. With a better protected eye we should never have been able to get that view of the 'starry heavens above' which provokes us to science. Aristotle has a polemical reference to this explanation of the reason for the fleshlessness of the skull, *de partibus Animal.* B. 656ª 15 *οὐ γὰρ ὥσπερ τινὲς λέγουσιν, ὅτι εἰ σαρκώδης ἦν* (sc. *ὁ ἐγκέφαλος*), *μακροβιώτερον ἂν ἦν τὸ γένος· ἀλλ' εὐαισθησίας ἕνεκεν ἄσαρκον εἶναί φασιν· αἰσθάνεσθαι μὲν γὰρ τῷ ἐγκεφάλῳ, τὴν δ' αἴσθησιν οὐ προσίεσθαι τὰ μόρια τὰ σαρκώδη λίαν. τούτων δ' οὐδέτερόν ἐστιν ἀληθές.* (For, according to him, the brain has nothing to do with *αἴσθησις*, and since it is his view that the 'flesh' is the actual 'medium' of touch, it is also false that flesh would be a hindrance to sensation.) His own theory is that, as the only function of the brain is to prevent the organism from being overheated, and the brain therefore itself requires to be kept cold, the skull has to be devoid of flesh because otherwise 'the brain would be heated to excess and so unable to cool any other part' (loc. cit. 656ª 19 *ἀλλὰ πολύσαρκος μὲν ὁ τόπος ὢν ὁ περὶ τὸν ἐγκέφαλον τοὐναντίον ἂν ἀπειργάζετο οὗ ἕνεκα ὑπάρχει τοῖς ζῴοις ὁ ἐγκέφαλος, οὐ γὰρ ἂν ἐδύνατο καταψύ-*

χειν ἀλεαίνων αὐτὸς λίαν). Moreover, to have flesh on the skull would have interfered with the erect posture, *οὐδὲν γὰρ ὀρθοῦσθαι δύναται φορτίον ἔχον, ἦν δ' ἂν τοιοῦτον, εἰ σεσαρκωμένην εἶχε τὴν κεφαλήν* (ib. 656^b 9).

75 c 4. ἅτε οὐδὲ καμπὰς ἔχουσαν. This is meant primarily to explain why *νεῦρα* are not required for the skull; it contains no joints to be flexed or stretched, and it was with a view to facilitating the flexure and extension of limbs with joints that the *νεῦρα* were devised. The absence of *σάρξ* has already been accounted for on other grounds, though T. probably means that a further function which he had ascribed to 'flesh', that of preventing 'falls' and the like, is the less requisite in the case of the skull because it contains no joints which could be dislocated.

75 c 7–d 5. τὰ δὲ νεῦρα . . . ἄρθρον ἄρθρῳ. Aristotle in the same way calls attention to the point that the bones of the head are not connected by *νεῦρα*, *Hist. Animal.* Γ. 515^b 11 ff. *πάντα γὰρ τὰ ὀστᾶ, ὅσα ἁπτόμενα πρὸς ἄλληλα σύγκειται, συνδέδενται νεύροις, καὶ περὶ πάντα ἐστὶ τὰ ὀστᾶ πλῆθος νεύρων. πλὴν ἐν τῇ κεφαλῇ οὐκ ἔστιν οὐδέν, ἀλλ' αἱ ῥαφαὶ αὗται τῶν ὀστῶν συνέχουσιν αὐτήν*, 'it is held together simply by the sutures'. So also Hippocrates *περὶ τόπων τῶν κατ' ἄνθρωπον* (Kühn ii. 108) quoted by A.-H. *τὸ μὲν σῶμα πᾶν ἔμπλεον νεύρων, περὶ δὲ τὸ πρόσωπον καὶ τὴν κεφαλὴν οὐκ ἔστι νεῦρα.* In d 2 *ὁμοιότητι*, as A.-H. says, is an instrumental dative; *ὁμοιότης* is, so to say, itself the solder (*κόλλα*) by which the *νεῦρα* are fastened round the neck at the base of the head. I take it the 'likeness' or 'uniformity' meant is symmetricality of disposition. (M.'s rendering gives the sense exactly, *les y* colla, *les uns aux autres, avec similitude.*) In *διὰ ταῦτα καὶ οὕτως* the *οὕτως* seems simply to repeat pleonastically the sense of *διὰ ταῦτα*.

75 d 3–4. καὶ τὰς σιαγόνας . . . προσώπου. The jaws are regarded as not properly a part of the *κεφαλή*, by which is meant simply the skull; hence the 'tying' of them is no exception to the statement about the absence of *νεῦρα* from the *κεφαλή*. Apparently also T. does not include the jaws in the *πρόσωπον*, 'face'. Aristotle's definition of the word is that it is 'that in *man* which lies between the head and the neck' (*τῶν δ' ἀνθρώπων καλεῖται τὸ μεταξὺ τῆς κεφαλῆς καὶ τοῦ αὐχένος πρόσωπον, de partibus Animal.* Γ. 662^b 18.

75 d 5–e 5. τὴν δὲ δὴ τοῦ στόματος . . . ναμάτων. Tongue, lips, and teeth serve a double end. The lower end is to take in food for the body; the higher is to serve as instruments of rational speech. In d 5–6 *τὴν τοῦ στόματος δύναμιν* is a mere periphrasis, like the commoner ones with *φύσις*, for *τὸ στόμα*.

75 e 1–2. τὴν μὲν εἴσοδον . . . τῶν ἀρίστων. The *ἀναγκαῖα*, the things 'one cannot do without', though they have no intrinsic worth, are food and drink, the *ἄριστα*, which have a real value, are *λόγοι*, discourses, as explained immediately. These are no mere *sine qua non*, they are intrinsically good. But I should hardly go so far as A.-H. who makes the contrast into one between 'means' and 'ends'. It seems to me that *λόγοι*, as well as *τροφή*, are 'means'; they 'subserve understanding', as T. says (*ὑπηρετοῦν φρονήσει*). But they are means which are themselves at the same time intrinsically good. Timaeus is alluding to the substantival use of the words *τὰ ἀναγκαῖα* = *necessaria*, 'the necessaries of

life' as e. g. at *Laws* 848 a 7 *τῶν ἀναγκαίων ἀπονεμηθὲν τρίτον μέρος ὦνιον ἐξ ἀνάγκης ἔστω τοῦτο μόνον.* Aristotle repeats the view that the ultimate *raison d'être* of lips and tongue is to make us capable of intelligent speech, *de partibus Animal.* B. 659^{b} 27 ff. *τοῖς μὲν οὖν ἄλλοις ζῴοις πρὸς σωτηρίαν τῶν ὀδόντων ἡ τῶν χειλῶν φύσις ἐστὶ καὶ πρὸς φυλακήν, . . . οἱ δ' ἄνθρωποι . . . φυλακῆς τε ἕνεκα* (sc. ἔχουσιν) *τῶν ὀδόντων ὥσπερ καὶ τὰ ἄλλα, καὶ μᾶλλον ἔτι διὰ τὸ εὖ· πρὸς γὰρ τὸ χρῆσθαι τῷ λόγῳ καὶ ταῦτα. ὥσπερ γὰρ τὴν γλῶτταν οὐχ ὁμοίαν τοῖς ἄλλοις ἐποίησεν ἡ φύσις, πρὸς ἐργασίας δύο καταχρησαμένη, . . . τὴν μὲν γλῶτταν τῶν τε χυμῶν ἕνεκεν καὶ τοῦ λόγου, τὰ δὲ χείλη τούτου τε ἕνεκεν καὶ τῆς τῶν ὀδόντων φυλακῆς.* This seems to be a conscious reproduction of T.

75 e 3. νᾶμα. It has not been expressly said in the preceding words that the supply of *τροφή* is a *νᾶμα*, but T. seems to be remembering his own phrase at 44 b 2 about the *τροφῆς ῥεῦμα.*

The spirit of the contrast between the two *νάματα* is identical with that of the evangelical distinction (Mark vii. 15 ff.) between that which goes in at the mouth and that which comes out of it. What goes in is intrinsically neither good nor bad, what comes out may be, as here, intrinsically very good, or, as in the turn given to the thought by our Lord, very bad.

75 e 5 — 76 a 6. τὴν δ' αὖ κεφαλὴν . . . συναγαγοῦσα. *The skin of the head.* For the reasons already given, the head was not to receive a covering of flesh, and at the same time it would have been dangerous to expose the bones of the skull to variations of temperature without protection. Hence it was given a covering of skin alone. It is explained that skin is a kind of film which forms on the outside surface of flesh and can be separated from it (as one can separate the 'skin' which forms e. g. on milk).

76 a 1. οὐ καταξηραινομένης. The MSS. evidence for the *οὐ* (A F Y) is much stronger than that for its omission (P and the corrector of A). But there is a serious difficulty, at least at first sight, and the editors are divided. Ficinus translates the *οὐ*, and in modern texts it is retained by Bekker, St., M., Hermann, the Zürich editors, Bt., Riv., rejected by A.-H., who suggests a correction to *αὖ*. This suggestion I feel to be wrong, as the *αὖ* would have an adversative sense which is here out of place. A.-H.'s argument against *οὐ* is that the film or rind (*λέμμα*) *is* formed by the drying of the exposed surface of the flesh. This is true and looks a good reason for rejecting the testimony of the MSS. But I believe that the majority of the editors have been right after all. The thought is that a film or rind was formed on the surface of the flesh, much as the crust forms on a loaf in the oven. This *λέμμα* itself is formed by drying. But I think T.'s point is that what is under it does not dry up. You get an outer film of dry skin, but there is the moist flesh underneath it. The drying does not penetrate further than the separable skin. So with the film on the surface of boiled milk. If you skim it off you find that it leaves the milk under it perfectly fluid. If this were not so, what would be the consequence? There would not be, as there is, any interval been the *λέμμα* and what lies below it. The *λέμμα* would fit the flesh below it 'like a glove'. Then it would not be so readily separable, and there would not

be enough of it to be pulled up over the skull. It is indispensable to the theory that the flesh should not shrink in the process. *It* must retain its dimensions, but the film which forms over it must be loose or roomy (*μεῖζον*). This, to my mind, justifies the *οὐ* of the MSS. Riv.'s rendering conveys the same sense. We take into account certain Aristotelian passages which seem to allude to the words. One of them is quoted by A.-H., *de generatione Animal.* 743^{b} 5, where Ar. says, speaking of the development of the embryo, the 'skin is formed as the flesh dries up, like the so-called *γραῦς* on boiled liquids', *τὸ δὲ δέρμα ξηραινομένης τῆς σαρκὸς γίνεται καθάπερ ἐπὶ τοῖς ἑψήμασιν ἡ καλουμένη γραῦς*. So we are told earlier in the same work, at 737^{a} 35 ff., that a scum forms on boiled foods when they are cooling, and Aristotle argues that something analogous happens in the development of an embryo, *τοῖς δ' ὑγροῖς μὲν σωματώδεσι δὲ θερμαινομένοις περίσταται, καθάπερ ἐν τοῖς ἑψήμασι ψυχομένοις τὸ περίξηρον*. From the analogue to this in the embryo, as a creature grows, develop skin, sinews, veins, membranes, and the glutinous constituents (*τὸ γλίσχρον*) in the body generally. These passages seem to involve an allusion to what Timaeus says, but it is not clear to me whether Aristotle read the words of the dialogue without the *οὐ* and meant to echo them, or with the *οὐ* and intended a tacit correction. There is not even any necessary contradiction between Aristotle and what our best MSS. make T. say. The phrase need not mean that the flesh undergoes no 'drying at all', but only that it, as distinct from the film which detaches itself, never 'desiccates'. It is quite possible to hold both that the 'stuff of flesh' never completely dries up and that the skin is formed by the drying of its exposed outer surface. Hence I would, I think, follow the weight of MSS. testimony in keeping the *οὐ*. *μεῖζον* ought not to be suspected. It means 'rather large', larger than would be barely sufficient to cover the flesh. It is because it is larger that it can grow round the skull and meet at the top.

76 a 2. *δέρμα τὸ νῦν λεγόμενον*. As the *τὸ νῦν* shows, this is a playful suggestion that *δέρμα* is derived from *λέμμα*, 'film', as though the original form of the word had been *λέρμα*. (Cf. *δάκρυον*, lat. *lacrima*.)

76 a 2–4. *τοῦτο δὲ . . . κεφαλήν*. A.-H. seems to treat the words *διὰ . . . νοτίδα* as if they chiefly explained *βλαστάνον* ('being nourished by the moisture belonging to the brain'). But I take it they principally explain *συνιὸν αὐτὸ πρὸς αὑτό*. The moisture 'glues' the edges of the skin together at the place where they meet on the crown of the head. The *νοτίς* gets out by exuding through the *ῥαφαί*.

76 a 6. *οἷον ἄμμα συναγαγοῦσα*. As a small point of grammar, *οἷον* does not go with *ἄμμα* but with *συναγαγοῦσα*, or rather with the whole clause. It is the common use of *οἷον* introducing and apologizing for a metaphor. Tr. 'closed it in and knotted it up'.

76 a 6–b 1. *τὸ δὲ τῶν ῥαφῶν . . . ἐλάττους*. The number of the sutures of the skull is not fixed but varies with the individual and depends on the extent to which the incoming *τροφή* in the formative period has disordered the revolutions of the 'circles in the head'. (See *supra* 43 b 5 ff.) Where the perturbation of the orbits is greatest the number of the sutures is greatest also (owing to the greater deformation of the originally 'spherical' brain). We must bear in mind that the sutures are still only partly closed at birth,

and close up definitely in the earliest years of infancy. Hence Tennyson's allusion in *In Memoriam*, 'But he forgets the days before | God shut the doorways of his head'. The editors naturally quote the interesting description of these sutures given at the beginning of the Hippocratean surgical manual *περὶ τῶν ἐν κεφαλῇ τρωμάτων* (§ 1, Kühlewein, ii. 1–2). We are told there, as by Timaeus, that the number varies, *οὐδὲ αἱ ῥαφαὶ τῆς κεφαλῆς πάντων κατὰ ταὐτὰ πεφύκασι*. In some heads the shape is that of a T (these are heads elongated in front), in those elongated behind it is ⊥, in heads with a double protuberance Ⅱ; in the roundest heads of all the figure is that of a letter chi (i.e. +, not as A.-H. assumes X; nothing is said of an obliquity of inclination). These round heads are those in which the circles have been least deformed, so that T.'s speculative explanation is meant to fit in with observed facts. The Hippocratean tract is a practical manual, an excellent example of the observational medical work distinctive of the school of Cos. The remarks about the sutures stand in no special connexion with the very practical discussion of wounds which they introduce, and have every appearance of being taken from some more theoretical source. Hence I should conjecture, in view of their coincidence with the briefer statement of T., that they may go back to Alcmaeon, the author of the doctrine about the circles in the head. It is likely that the whole account of the perturbations of the circles in infancy which we had at 43 b ff. comes from him. T. wishes to suggest that the typically human skull should be as nearly round as it can be, to retain the shape of the *κόσμος*. In those who from the first have been 'greedy feeders', the head itself is deformed into an ellipsoid and elongated along one of its axes. This makes such heads beast-like, and has, of course, an effect on the direction followed by the sutures as the skull closes up in the first year or two of infancy. Aristotle asserts (*Hist. Animal.* A. 491^{b} 2 *ἔχει δὲ ῥαφὰς τῶν μὲν γυναικῶν μίαν κύκλῳ, τῶν δ' ἀνδρῶν τρεῖς εἰς ἓν συναπτούσας ὡς ἐπὶ τὸ πολύ*, Γ. 516^{a} 18 *τὸ μὲν θῆλυ κύκλῳ ἔχει τὴν ῥαφήν, τὸ δ' ἄρρεν τρεῖς ῥαφὰς ἄνωθεν συναπτούσας, τριγωνοειδεῖς*) that in a woman's skull there is only one circular suture, in a man's there are three, as a rule, though there are exceptional cases. T. has no occasion to speak of *τὸ θῆλυ*, as there are no women in his *πρώτη γένεσις*. It does not appear where Aristotle got his statement about the female skull, which is notoriously false.

76 b 1–e 6. *τοῦτο δὴ πᾶν . . . ἔφυσαν.* *Hair and nails.* Hair is an excrescence from the skin. The fire in *τὸ θεῖον* (i.e. the brain) makes punctures in the skin—remember the pointed shape of the pyramids of 'fire'—as it forms round the head. Moisture (cf. *νοτίδα*, 76 a 3) exudes through these punctures, and such of this moisture as is not evaporated and retains the other ingredients of skin (the water and earth of 74 c 7) is then pushed out in the form of cylindrical threads. Hair is thus of the same character as skin but is hardened and 'packed together' by exposure to the cold of the external air as it grows. The air pushes the point of the hair down under the skin again so that it takes root there.

76 b 2. *τρηθέντος.* All the MSS. have *τρωθέντος*, which is retained by Hermann and A.-H. But the preceding *κατεκέντει* shows that the metaphor is from the piercing of stuff by a needle. Hence Coraes seems

to have been probably right in restoring *τρηθέντος*. For a parallel instance of confusion between the two words cf. Aesch. *Ag.* 868, where Clytemenestra says that if Agamemnon had really been wounded as often as the official reports pretended *τέτρηται δικτύου πλέον λέγειν*, he must be fuller of holes than a fishing-net. Here also the MSS. give *τέτρωται*, but Ahrens's emendation *τέτρηται* is much more in keeping with the tone of the speech.

ib. **τῆς ἰκμάδος**. The word is specifically Ionic for Attic *ὑγρότης* or *τὸ ὑγρόν*, and the employment of it, like that of *πιλήσει* and *συνεπιλήθη* below, is intentional imitation of the vocabulary of fifth-century Ionic science. The word is used in the same way for comic effect by Aristophanes (*Clouds* 233) when Socrates explains that he 'cogitates' in a basket (?) to keep the *ἰκμάς* of his *φροντίς* immune from the effect of proximity to the earth, both *ἰκμάς* and *φροντίς* in the sense of 'thought' being Ionic words.

76 b 4. τὸ δὲ μεικτὸν ἐξ ὧν καὶ τὸ δέρμα ἦν. As *δέρμα* is supposed to be a scum formed on the exposed surface of *σάρξ*, this *μεικτόν* will be what is left of the *ὕδωρ* mingled with the *γῆ* which is also an ingredient in *σάρξ*. The hair is fine and thin because the puncture through which the *ἰκμάς* gets out is tiny; it is drawn into a long thread because the *ἰκμάς* is trying hard to get out at this tiny perforation. The effect of the presence of the external air is to repel it, so that we are finally to think of a hair as a cylindrical thread which has been looped back till the two ends are brought together and twisted tight under the skin. The *περιεστῶτος* of b 7 is again a piece of Ionic terminology for that which 'surrounds us'.

For the part assigned to *ἰκμάς* in connexion with the formation of hair cf. the remark in the Hippocratean *περὶ ἀδένων* that hair and glands are both found in the same regions of the body, since both thrive on the body's superfluous moisture *ὅκου δὲ αὐὸν ἐὸν τὸ σῶμα, οὔτε ἀδὴν οὔτε θρίξ* (Kühn i. 493). Aristotle likewise regards hair as nourished by *τὸ ὑγρόν* (*Hist. Animal.* Γ. 518^{b} 13 *ἔχει δὲ πᾶσα θρὶξ ὑγρότητα πρὸς τῇ ῥίζῃ γλίσχραν καὶ ἕλκει εὐθὺς ἐκτιλθεῖσα τὰ κοῦφα θιγγάνουσα*). On the other hand *θρίξ* itself is one of the *ξηρὰ καὶ στερεά* of the body (*Hist. Animal.* A. 487^{a} 7, like skin, bone, nails, &c., and hence it is mentioned at *de Anima* A. 410^{b} 1 among the *ὅσα ἔνεστιν ἐν τοῖς τῶν ζῴων σώμασιν ἁπλῶς γῆς*, which agrees so far with what Timaeus says about *τὸ μεικτὸν ἐξ ὧν καὶ τὸ δέρμα ἦν*. The view that *γῆ* is a prominent ingredient in *θρίξ* seems to go back to Empedocles who says (Fr. 76) that we may see from the cases of shell-fish and turtles and the like that the earth in animals forces itself to the outside of the skin, and again (Fr. 82) that hair, feathers, leaves, scales are all the same kind of thing, *ταὐτὰ τρίχες καὶ φύλλα καὶ οἰωνῶν πτερὰ πυκνὰ | καὶ λεπίδες γίγνονται ἐπὶ στιβαροῖσι μέλεσσιν*.

76 c 1. εἰλλόμενον. This is the spelling of W, and, except for the rough breathing, A; here the meaning is that the hair got rooted tightly in the skin in the very process of being twisted round on itself. Thus *here* the present participle is strictly in place.

76 c 3. τῇ πιλήσει τῆς ψύξεως. *τῆς ψύξεως* seems to be a definitory genitive, 'the felting which consists in cooling'. This takes us back to the theory of Anaximenes, who introduced the machinery of condensation and

rarefaction into Greek science. He held, contrary to fact, that ἀήρ becomes warmer by rarefaction and colder by condensation on the ground that when we breathe with our mouths open, the air feels warm, when we breathe with our lips close together, it feels cold (R. P. 27, *EGPh.*[3] 75).

76 c 5–d 3. τούτῳ δὴ . . . γενησόμενον. Thus the function of the hair on the head is to serve as a kind of natural felt hat (πίλησις itself suggests this, as the word properly means the conversion of wool into felt by packing layers of it close together). Such a light natural hat serves the double purpose of keeping the head warm in winter and protecting it from sunstroke in summer without interfering with the assumed high sensibility of the brain as a heavier covering might do.

76 d 3–e 6. τὸ δ' ἐν τῇ περὶ τοὺς δακτύλους . . . ἔφυσαν. *The nails.* They are a kind of specially hard skin formed at the ends of our fingers and toes (δάκτυλοι in Greek means both equally) by the twisting together of skin proper, bone, and sinew, all hardened into one. The subject of the γέγονεν is τὸ τοῦ νεύρου καὶ τοῦ δέρματος ὀστοῦ τε, 'sinew, skin, and bone at the place where they are twisted together in fingers and toes'. συμμειχθὲν ἐκ τριῶν qualifies this adjectivally. The συναιτίοις of d 6 are the three constituents, the 'material cause', in Aristotelian language, of the resultant nail as opposed to the αἰτιωτάτη διάνοια, the 'intentional' or 'final' cause, which alone deserves the name of αἰτία. For pre-Platonic use of the distinction between αἰτία and συναίτια one may probably cite from the medical writers Hippocrates περὶ φυσῶν (Kühn i. 586) τὰ δ' ἄλλα πάντα συναίτια καὶ μεταίτια (sc. of disease), τὸ δὲ αἴτιον τῶν νούσων ἓν τοῦτο ἐπιδεδείκταί μοι (the writer's theory being that the real *cause* of every disease is φῦσα, accumulation of wind somewhere in the body; all other alleged causes are only 'predisposing conditions').

76 d 7–8. τῶν ἔπειτα . . . εἰργασμένον. A.-H. finds in this 'very singular declaration' an anticipation of Darwin. C. W. regards it as a mere jest, the point lying in the mention of 'women', to whom the nails would be very useful weapons. The mention of women is probably a jest with the point he supposes, but the allusion means more than that. Nothing is said by T. about fighting as primarily or solely the use to which the ὄνυχες will be put when they are fully developed. Indeed, it is said that they will have many uses. The development of them is meant to account not only for claws and talons but for *hoofs*, and the main use of hoofs, claws, and talons is not to fight with. Hence the jest about the 'natural weapons of women' cannot be the whole nor the greater part of T.'s meaning. T. is, as usual, following the lines of earlier science. The general notion of a gradual evolution of species is as old as Anaximander's assertion that man is descended from a marine animal (R. P. 22). This was not a 'guess' but a theory based on the conviction that the human infant is exceptionally helpless, and consequently if 'man had always been as he is now' the species could not have survived, and further confirmed by accurate observations about the early life-history of certain sharks (R. P. 22, *EGPh.*[3] 71). Empedocles, whom T. is once more following, had developed the idea of evolution further than any one else. According to him, species capable of survival come into being at two contrasted periods of the world's history, when strife has sufficiently

overcome love to make such differentiation possible, and again in the opposite half of the cycle (the half in which we are *not* living), when love has so far reunited the sphere as to make compounds of the 'roots' possible once more. In both cases, the creatures which survive are a selection from a much greater number of types, most of which soon perished from maladaptation. (See the description of these processes in Empedocles Frs. 57–61, R. P. 173 a, b, c, and the comments of *EGPh.*[3] 242–4.) T.'s recognition of the principle of the survival and development of 'useful' variations comes from Empedocles.

76 e 4. ὑπετυπώσαντο. The word introduces the notion of a 'rudimentary' organ; 'they show the first outline', 'make the initial sketch'; our ὄνυχες, it is meant, are not really fully developed; the claws and talons and hoofs of the beasts are the true ὄνυχες. A view of the materials of the nails, not unlike that given here, seems to be intended in the Hippocratean περὶ φύσιος παιδίου (Kühn i. 397–8) ἐκ δὲ τῶν δακτύλων ἅτε πυκνὰ ἐχόντων ὀστέα σμικρὰ καὶ φλέβας καὶ νεῦρα, οὕτως οἱ ὄνυχες φύονται ἐξ αὐτῶν λεπτοὶ καὶ πυκνοί . . . ὥστε μὴ θαυμάζειν ὅτι οἱ ὄνυχες ἐξωτάτω τοῦ σώματος πυκνοτατοί εἰσιν· ἐκ γὰρ τῶν πυκνοτάτων εἰσίν, where the only difference lies in the mention of φλέβες instead of δέρμα as the third constituent. Aristotle tells us that Empedocles has said that nails are formed from νεῦρα by 'solidification' (περὶ πνεύματος, 484[a] 38 Ἐ. δὲ ἐκ νεύρου τὸν ὄνυχα τῇ πήξει). Ar. himself classes the nails with the rest of the ξηρὰ καὶ στερεά, bones, νεῦρα, and the like. They are formed from the 'surplus' nutriment taken in by the body, ἐκ τῆς ἐπικτήτου τροφῆς καὶ τῆς αὐξητικῆς, ἥν τε παρὰ τοῦ θήλεος ἐπικτᾶται (sc. before birth) καὶ τῆς θύραθεν (*de generat. Animal.* 745[a] 3). As for their functions, Aristotle mentions self-defence (τὸ ἀμύνειν, *de partibus Animal.* Γ. 662[b] 34), and also a very important use which they subserve in man not mentioned by Timaeus, viz. that they act as sheaths to protect the tips of fingers and toes from injury, op. cit. Δ. 687[b] 22 εὖ δὲ καὶ τὸ τῶν ὀνύχων μεμηχάνηται· τὰ μὲν γὰρ ἄλλα ζῷα ἔχει καὶ πρὸς χρῆσιν αὐτούς, τοῖς δ' ἀνθρώποις ἐπικαλυπτήρια· σκεπάσματα γὰρ τῶν ἀκρωτηρίων εἰσίν.

76 e 5. ταῖς προφάσεσιν, 'from these causes'. The use of πρόφασις in this sense is particularly frequent in the Hippocratean *corpus*, e. g. in the constantly recurring phrase, used of attacks of illness, ἄνευ φανερῆς προφάσιος, 'without visible cause'.

ib. **δέρμα.** A.-H.'s insertion of τε after the following τρίχας is uncalled-for. With the text of the MSS. τρίχας ὄνυχάς τε are a proleptic apposition with δέρμα, 'they made skin grow into hair and into nails at the extremities of the limbs'. Even with a τε inserted this would still be the right construction.

76 e 7—77 c 5. Ἐπειδὴ δὲ . . . ἐστερῆσθαι. *The production of trees and plants.* Since man's life is spent in 'fire and air'—i. e. he is exposed to sun and wind—he suffers the wasting of his powers by the action of both, and to make good this waste he needs aliment. To meet this need, the gods created vegetation at the same time as man. The vegetables are alive and are therefore properly to be called ζῷα, but they have only the kind of life which belongs to the ἐπιθυμητικόν in ourselves, appetition and a sense of pleasure and pain.

77 a 1. *ἐν πυρὶ καὶ πνεύματι.* I believe that A.-H.'s explanation here is wrong, as it presupposes the whole account of respiration and digestion, topics of which nothing has been said. And the *πῦρ in* which we are said to live cannot well be the internal heat of the organism. The sense is that we are constantly exposed—especially men like the ancient Greeks who spent all their day in the open air—to the heat of the sun and the cold of the winds. It is the parching heats and the cutting winds which 'empty' and 'waste' our frame.

77 a 4. *συγγενῆ . . . φύσιν.* Trees and plants, unlike the lower animals, are as old as mankind, for whose service they were made. *συγγενῆ* is clearly to be taken with the full literal sense, 'born along with', 'coeval with', exactly as in Aristotle *Hist. Animal.* Γ. 518ª 18 *εἰσὶ δὲ τῶν τριχῶν αἱ μὲν συγγενεῖς, αἱ δ' ὕστερον κατὰ τὰς ἡλικίας γινόμεναι ἐν ἀνθρώπῳ μόνῳ τῶν ζῴων*, 'in man hair in some parts is congenital, in others it appears as the man grows up'. T. is going to account for all other animals as evolved from man by degeneration. The original diet of men cannot have been animal for this reason, but since he has always needed some diet to repair the ravages of sun and wind, we must suppose edible vegetables to be as old as the human race. This again is Empedocles. It is wrong to draw any inferences from the passage to the personal theory or practice of Plato. We cannot even use it to decide the disputed point whether the Pythagorean society was 'vegetarian', though we may fairly infer that Timaeus himself is meant to be so. This may, however, be due to the influence of Empedocles. In the remaining fragments of E.'s poem on *Purifications* all flesh-eating is denounced as cannibalism (Frs. 135, 128, 137, R. P. 183, 184, 184 b). Still all that T. actually says is that man's first diet was vegetable, as it must have been if there were no animals for the first men to feed on. In a climate like that of Greece or S. Italy, there is little meat-eating. The people are still in the main feeders on vegetables. That a philosopher at Athens or Locri should assume that vegetables are the original and the staple food of mankind is natural. A more important point is that T. follows Empedocles in holding that vegetation was produced—in the case of E. this must be understood to refer to our own half of the cosmic cycle, that in which strife is gradually breaking up things—at an earlier stage of the differentiation of the 'sphere' than animals. E. held this because he had observed that the two sexes are united in the same organism in plants (Aetius *Placita* v. 26, *Doxogr. Graec.* 438, R. P. 172 Ἐ. *πρῶτα τὰ δένδρα τῶν ζῴων ἐκ γῆς ἀναφῦναί φησι . . . διὰ δὲ συμμετρίαν τῆς κράσεως τὸν τοῦ ἄρρενος καὶ τοῦ θήλεος περιέχειν λόγον*), whereas they are divided in animals. He held, for the same reason, that in the half of the cycle to which our world belongs the first animals were bisexual (Fr. 61, R. P. 173 b *μεμειγμένα τῇ μὲν ἀπ' ἀνδρῶν, | τῇ δὲ γυναικοφυῇ*, Fr. 62, R. P. 173 c *οὐλοφυεῖς μὲν πρῶτα τύποι χθονὸς ἐξανέτελλον*), though these creatures, being sterile, did not survive. It is on this that Plato has based the humorous myth of the subsequent bisection of these beings by Zeus, which he puts into the mouth of Aristophanes in the *Symposium*. Timaeus regards the anatomical and physiological differentiation of the sexes as only arising in his second generation. His own *γηγενεῖς*, like the burlesque on the conception put

into the mouth of Aristophanes in the *Symposium*, have not the distinction of sex. (They are called ἄνθρωποι, but they are not supposed to have the anatomy of a male human being of to-day.) This fits in exactly with the Empedoclean theory. The one point in which T. does not follow E., though he may quite well be following some forgotten cosmogony, is in making these earliest animals human. (The bisexual character of the γηγενεῖς reappears in the myth of the *Politicus* (p. 271) along with their vegetarianism, and is therefore a genuine feature of old cosmogonical tradition.) The point to be grasped, then, is that we are still on the ground of Empedoclean cosmology.

77 a 4–5. ἄλλαις ἰδέαις καὶ αἰσθήσεσιν. ἰδέαι, 'shapes', 'figures', may be taken to refer particularly to visible form, but probably means nothing more definite than 'qualities', 'characters'. As for the αἰσθήσεις, we are told below that plants feel pleasure and pain 'along with appetites'. But they have no δόξαι, i. e. they have nothing which we should call 'perception of objects'; that, in Platonic language, is δόξα μετ' αἰσθήσεως. So the thought is that a plant can e. g. feel hungry or thirsty and can enjoy nutriment, sunshine, &c. ('every flower enjoys the air it breathes'), but no more. Empedocles seems to have gone further in attributing ψυχή to plants ([Arist.] *de Plantis* A. 815ª 15 Ἀναξαγόρας μὲν οὖν καὶ Ἐμπεδοκλῆς ἐπιθυμίᾳ ταῦτα κινεῖσθαι λέγουσιν, αἰσθάνεσθαί τε καὶ λυπεῖσθαι καὶ ἥδεσθαι διαβεβαιοῦνται, *EGPh.*³ 241). As for the statement of the *de Plantis* (815ᵇ 11)—a retranslation from Latin of a translation from Arabic of a work falsely ascribed to Aristotle—that Empedocles, Anaxagoras, Democritus all ascribe γνῶσις and νοῦς to plants, it does not mean much. For, as Aristotle expressly said (*de Anima* Γ. 427ª 21), E. (R. P. 177) and the ἀρχαῖοι in general did not distinguish τὸ φρονεῖν, 'thought', from τὸ αἰσθάνεσθαι, 'sense' (οἵ γε ἀρχαῖοι τὸ φρονεῖν καὶ τὸ αἰσθάνεσθαι ταὐτὸν εἶναί φασιν, ὥσπερ καὶ Ἐμπεδοκλῆς εἴρηκε, "πρὸς παρεὸν γὰρ μῆτις ἀέξεται ἀνθρώποισι" κτλ.), and the same thing is probably equally true of Anaxagoras (at least this is suggested by Arist. *de Anima* A. 404ᵇ 1, R. P. 154 b Ἀ. δ' ἧττον διασαφεῖ περὶ αὐτῶν· πολλαχοῦ μὲν γὰρ τὸ αἴτιον τοῦ καλῶς καὶ ὀρθῶς τὸν νοῦν λέγει, ἑτέρωθι δὲ τοῦτον εἶναι τὴν ψυχήν· ἐν ἅπασι γὰρ ὑπάρχειν αὐτὸν τοῖς ζῴοις, καὶ μεγάλοις καὶ μικροῖς, καὶ τιμίοις καὶ ἀτιμοτέροις) and of Democritus (Arist. *de Anima* A. 404ª 27, R. P. 204 b, where it is said of him ἁπλῶς ταὐτὸν [sc. φησὶ] ψυχὴν καὶ νοῦν· τὸ γὰρ ἀληθὲς εἶναι τὸ φαινόμενον· διὸ καλῶς ποιῆσαι τὸν Ὅμηρον ὡς Ἕκτωρ κεῖτ' ἀλλοφρονέων). As the distinction between thought and sense had been insisted or by Alcmaeon, there is no anachronism in making T. depart here from Empedocles. What he says amounts virtually to Aristotle's doctrine that plants have only the θρεπτικὴ ψυχή, are just so far alive as to be able to assimilate nutriment and to grow, except that T. assumes that this degree of life is attended by pleasure and pain, and that he calls the plant's tendency to reach out after nutriment and turn to the light ἐπιθυμία, whereas Aristotle regards the whole of the plant's activity as unconscious.

77 a 5. ὥσθ' ἕτερον ζῷον εἶναι. In giving the name ζῷον or *animal*, to the plant T. appears to be simply following the terminology of Empedocles, if we may trust the *de Plantis*, where it is said (815ª 18, in con-

nexion with the view ascribed in common to Anaxagoras and Empedocles) that Anaxagoras calls them ζῷα. As the views of the two are treated as identical, it may fairly be presumed that E. also made no sharp distinction between ζῷα and φυτά. How far he was from doing so is visible from Fr. 117 (R. P. 182) where he mentions a 'bush' along with a 'boy', a 'girl', a 'kid', and a 'fish' among his own past transformations. Aristotle restricted the name ζῷον to creatures which have sensation, and thus excluded φυτά from the class of ζῷα (cf. *de Anima* B. 415ᵃ 2 τοῦ δ' αἰσθητικοῦ χωρίζεται τὸ θρεπτικὸν ἐν τοῖς φυτοῖς).

77 a 6–8. ἃ δὴ νῦν ἥμερα . . . ὄντα. These remarks are meant to soften down any paradoxicality which may be felt in the application of the name ζῷα to plants by reminding us that they, like animals, have been 'domesticated', and that we use the same adjectives to distinguish the 'wild' (ἄγρια) from the domesticated (ἥμερα) with reference to both 'kingdoms'. From the existing distinction of ἄγρια and ἥμερα δένδρα it is not such a very great step to use παιδεύειν of the 'training' of a vine, shoot, or the like, or even to applying the word τιθασός, 'tame', properly used only of animals, to trees. If you have 'wild' trees (wild pear and the like), why may you not talk about 'tame' ones? For the γεωργός as a kind of 'trainer', and so an educator of something, cf. *Sophistes* 219 a 10 γεωργία μὲν καὶ ὅση περὶ τὸ θνητὸν πᾶν σῶμα θεραπεία.

77 b 5–6. αἰσθήσεως . . . ἐπιθυμιῶν. What is meant by the αἴσθησις here ascribed to φυτά? It is not likely that αἴσθησις ἡδεῖα καὶ ἀλγεινή means merely 'sensibility to pleasure and pain'. Pleasure and pain are not themselves αἰσθήσεις, but reactions to αἰσθήσεις or δόξαι or ὑπολήψεις. Timaeus has called them αἰσθητὰ παθήματα, 'states connected with αἴσθησις', but has hitherto by implication distinguished them from αἰσθήσεις. Cf. 64 a 4–6, where λῦπαι and ἡδοναί are clearly discriminated from αἰσθήσεις. Hence I think he probably means to assign to φυτά actual sensations of warmth and cold, dryness and moisture. We cannot suppose that he credits them with the more special sensitivities to colours or sounds or the like, as they have not the corresponding αἰσθητήρια.

77 b 6–c 3. πάσχον γὰρ διατελεῖ πάντα . . . γένεσις. That is, the φυτόν is merely worked on by external agents. In a sense, like all things which have a ψυχή, it no doubt 'moves itself'. But its ψυχή does no more than produce responses from within to the stimuli which act on the φυτόν from without. As we are told below, it has not ἡ ὑφ' ἑαυτοῦ κίνησις as an animal has. Hence the plant 'takes things as they come'. It can turn to the sun 'when the sun shines on it'; it cannot look out a 'place in the sun' for itself, as an animal would. The construction and sense of the clause στραφέντι—γένεσις was pointed out by Zeller (*Phil. d. Griechen*³ ii. 1, 731 n. 5), except that he presupposes the false reading φύσιν for φύσει in 77 c 2. 'It is always wholly passive; its formation (γένεσις) has not permitted it, in the course of kind, to perceive and reflect on itself, revolving in itself about itself, rejecting movement from without and employing a movement of its own.' That is, the words ἀπωσαμένῳ . . . χρησαμένῳ are parallel in meaning to στραφέντι . . . ἑαυτό, both clauses going with λογίσασθαι. The 'formation of the plant does not allow it to revolve on itself' at all, and that is why it does not 'reflect'. So also Apelt in

his German version and Rivaud. A.-H. and M. suppose the meaning to be that the plant *does* 'revolve on itself' and does 'reject motion from without'. But this makes T.'s whole theory of κίνησις self-contradictory. It was precisely because the οὐρανός rejected motion from without and revolved wholly on itself that it was held to be supereminently intelligent. The point here must be that a φυτόν has *not* a genuine οἰκεία κίνησις at all. All its movement in response to external stimuli is determined in character by the nature of the stimuli. This is not the case with the most rudimentary animalculae. In c 2 φύσει, the reading of A F Y, Par. 1812, Stobaeus is clearly right against φύσιν of W and inferior MSS. It goes as an 'instrumental' dative with παραδέδωκεν, 'in course of kind'. φύσιν, if sound, I suppose would be object. accus. after κατιδόντι. But κατιδεῖν φύσιν could not mean 'to discern its *own* nature'; it would have to mean 'to have cognizance of Nature', and Timaeus would be saying that trees do not study 'natural science'. Or φύσιν might be taken to be governed by παραδέδωκεν, but παραδιδόναι φύσιν λογίσασθαι, 'to bestow a nature capable of reflection' would surely be strange Greek. (I am not sure which construction M. and A.-H. intend by their versions.)

77 c 6—79 a 4. Ταῦτα δὴ τὰ γένη . . . ποιεῖ ῥεύματα. Timaeus now proceeds to give an account of the threefold process of circulation of the blood, digestion, and respiration. He is basing his account on that of Empedocles, apart from which it is not really intelligible. There is no part of the dialogue where it is more important to remember that Plato is either reproducing or imagining a fifth-century doctrine founded on the theories of an eminent fifth-century man of science, not constructing a novel hypothesis of his own. If we forget this and insist on judging the speculation on its own merits, we do Plato a real injustice. Galen, who discusses the subject in the eighth book of his *de Hippocratis et Platonis placitis*, attempts to take this point of view and finds himself driven, in consequence, to charge Plato with inexcusable incoherency and carelessness. If we imitate Galen in our neglect of the dramatic character of the dialogue, we shall, I believe, be forced to accept his condemnation. But if we remember that the speaker is a fifth-century contemporary of Empedocles, under the influence of that thinker, we shall find that the whole theory is dramatically appropriate. What is essential is to understand that the whole theory starts from the poem of Empedocles, and that the peculiarity of E.'s doctrine was that he regarded the circulation of the blood and respiration as one single great organic process. The key to our passage is E.'s view that we inhale the air not merely at mouth and nostrils but through all the πόροι in the skin (to use Galen's phrase, by διαπνοή as well as by ἀναπνοή), and that the regular alternation of inhalation and exhalation, or rather, as he and T. would say, of exhalation and inhalation, is an effect of the systole and diastole of the heart and the arteries. To appreciate T.'s account of the combined processes of digestion and respiration it is indispensable to have a clear understanding of this theory of Empedocles, though, for convenience, we may defer a study of it until we have heard the anatomical details about the path of the blood-vessels which irrigate the body.

77 c 7–8. διωχέτευσαν . . . ὀχετούς. The higher powers provided our

body with a system of channels 'like the runnels in a garden'. In a denuded district like Attica, a kitchen-garden must be artificially watered. (The same consideration explains why provisions about the rights of farmers to cut such channels, and the restrictions necessary to prevent a man from diverting a watercourse to the detriment of his neighbours, are treated at such length in the *Laws*.) The two main 'channels' are, no doubt, the two which are always dwelt on at length in similar descriptions in the Hippocratean writings, the μεγάλη φλέψ—really ἀρτηρία, or aorta—and the κοίλη φλέψ or *vena cava*. (We must remember that the distinction between arteries and veins was not clearly drawn until it was established by Praxagoras of Cos at the very end of the fourth century; it is still unknown to Aristotle. Praxagoras himself wrongly inferred from the absence of blood in the arteries after death that it is also absent in life, and supposed these vessels to be channels for πνεῦμα taken in from the surrounding atmosphere.) Plato and Aristotle both rightly regard the arteries, called by them φλέβες, as containing blood, though Aristotle supposed the blood in these 'veins' to be mingled with what he calls πνεῦμα, the vapour produced by the internal heat of the body from the blood. (See Martin, n. clxiii.) It is this same πνεῦμα which, under the name of 'animal spirits', plays so prominent a part in the physiology and psycho-physics of Descartes. Galen, throughout the *de Hippocratis et Platonis placitis*, is eloquent about the error of Praxagoras and the numerous physicians who had adopted his theory. His own view is that the arteries contain blood which is mingled with ζωτικὸν πνεῦμα, elaborated by the heart, but he distinguishes this 'animal spirit' carefully from the ψυχικὸν πνεῦμα which is elaborated in the ventricles of the brain and conducted thence down the nerves to the sense-organs and 'voluntary' muscles. The true nature of the circulatory process, it must not be forgotten, was a discovery of the seventeenth century A.D., only finally completed when Malpighi actually discovered under the microscope the 'capillaries' whose existence Harvey had postulated. The mere anatomical structure of the venous and arterial systems had been carefully studied in the fifth century. In the Hippocratean corpus there is an elaborate account at the end of the περὶ φύσιος ἀνθρώπου (Kühn i. 364–6) and another in the περὶ τόπων τῶν κατ' ἄνθρωπον (Kühn ii. 104–7). Aristotle, before giving his own account, in *Historia Animal.* Γ. 513ᵃ 15 ff., quotes three earlier descriptions, one from Syennesis the Cypriote, a second from Diogenes of Apollonia (Diogenes Fr. 6, Diels *Fr. d. Vors.*³ i. 427–9), and a third from 'Polybus the nephew of Hippocrates'. This third description is precisely that of the περὶ φύσιος ἀνθρώπου. (Galen, however, vigorously denies that the account represents the doctrine of the school of Cos, and is anxious to reject it as an unscrupulous and inept later interpolation.) Aristotle complains strongly of some predecessors, of whom Polybus appears to be one, who had tried to make the brain the ἀρχὴ τῶν φλεβῶν. (On the whole subject I may refer to the notes in Professor D'Arcy Thompson's version of the *Historia Animalium*.) Aristotle, like Timaeus, regards the heart as the centre of the whole vascular system, which he describes fully though with some remarkable confusions. (For example, he appears not to have distinguished the aorta from the pulmonary artery.

For a true description of the *μεγάλη φλέψ*, or aorta, and the *vena cava* see Huxley *Elementary Lessons in Physiology* ii.) The analogy from the watering of gardens seems to have been a standing one. Cf. Hippocr. *περὶ ἀρχῶν* (or *σαρκῶν*), Kühn i. 435 *ἀρδόμενα γὰρ ὑπὸ τῆς τροφῆς αὔξεται ἕκαστα, τὸ θερμὸν καὶ τὸ ψυχρὸν καὶ τὸ κολλῶδες καὶ τὸ λιπαρὸν καὶ τὸ γλυκὺ καὶ τὸ πικρὸν καὶ τὰ ὀστέα καὶ τὰ ἀλλὰ ξύμπαντα ὁκόσα ἐν τῷ ἀνθρώπῳ ἐνῇ* (? l. *ἔνι*), and for the garden, Hippocr. *περὶ χυμῶν*, Kühn i. 128 *ὥσπερ τοῖσι δένδροισιν ἡ γῆ, οὕτω τοῖσι ζῴοισιν ἡ γαστὴρ καὶ τρέφει καὶ θερμαίνει καὶ ψύχει. ψύχει μὲν κενουμένη, θερμαίνει δὲ πληρουμένη. ὥσπερ γῆ κοπρευομένη χειμῶνος θερμή, οὕτω καὶ ἡ κοιλίη.* A closer parallel is Aristot. *de partibus Animal.* Γ. 668ª 13, which seems to be a reminiscence of the present passage, *ἔοικε δ' ὥσπερ ἔν τε τοῖς κήποις αἱ ὑδραγωγίαι κατασκευάζονται ἀπὸ μιᾶς ἀρχῆς καὶ πηγῆς εἰς πολλοὺς ὀχετοὺς καὶ ἄλλους ἀεὶ πρὸς τὸ πάντῃ μεταδιδόναι . . . τὸν αὐτὸν τρόπον καὶ ἡ φύσις τὸ αἷμα διὰ παντὸς ὠχέτευκε τοῦ σώματος, ἐπειδὴ παντὸς ὕλη πέφυκε τοῦτο.*

77 d 2. δίδυμον. If we read the singular (with F W Y A²) as against the *διδύμους* of A, we must regard the position of the adjective as due to 'hyperbaton' (so rightly St. and M.). 'They cut two veins as channels . . . even as the body is a twofold thing with a right and a left.' If we retain the *διδύμους* of A (so A.-H. and Hermann), I do not see how we can well avoid inserting a conjectural ⟨*δίδυμον*⟩ after it. Worst of all seems the reading of Bekker and the Zürich editors who print *δίδυμον* with a comma after it, if this is anything more than a printer's error. To construe it, we should have to suppose *δίδυμον* to be in apposition to *φλέβας*, 'a twofold thing', and then, I think, as with *διδύμους*, insert another *δίδυμον* to go with the following clause.

77 d 3–4. καὶ τὸν γόνιμον . . . μυελόν. It ought to be needless to mention that *καί* here is not 'and' but 'also'.

77 d 5. ἐπὶ κάτωντες. T. seems to suppose that both the aorta and *vena cava* run downwards throughout their course. As M. is careful to explain (n. clxiv) this, if it is what is meant, is false anatomy. Contrast the words of Diogenes of Apollonia (Fr. 6 ap. Aristot. *Historia Animal.* Γ. 511ᵇ 32 ff. *αὗται τείνουσι διὰ τῆς κοιλίας παρὰ τὴν νωτιαίαν ἄκανθαν, ἡ μὲν ἐπὶ δεξιὰ* [*vena cava*] *ἡ δ' ἐπ' ἀριστερά* [aorta], *εἰς τὰ σκέλη ἑκατέρα τὰ παρ' ἑαυτῇ, καὶ ἄνω εἰς τὴν κεφαλὴν παρὰ τὰς κλεῖδας διὰ τῶν σφαγῶν.* But one may say in excuse for such an oversight what Galen says (*de Hippocratis et Platonis placitis* viii. 701 [Kühn 696]) about another matter, *ἴσως οὐκ ἠδύνατο περὶ τῶν τοιούτων ἀκριβῶς διελθεῖν ἐμπειρίας δεομένων, αὐτὸς οὐκ ὢν τρίβων τῶν ἔργων τῆς ἰατρικῆς, καὶ κατὰ τοῦτο ἐπαινεῖν αὐτὸν προσήκει, περὶ ὧν ἀκριβῶς οὐκ ἠπίστατο, μηδὲ ἐπιχειρήσαντα λέγειν.* It is worth noting that no further details are given about the vascular system, though Plato could easily have borrowed from the fifth-century descriptions. It looks as though Galen were right in supposing that he purposely avoided the dangerous use of borrowed information.

77 e 1. πλέξαντες διεῖσαν. That is, at the neck the *φλέβες* are crossed through one another, so that two results are obtained. The head is lashed firmly to the body. (This has to be secured by the decussation of the *φλέβες* because the *νεῦρα* are absent from the head.) Also there is a communication kept up between the brain as a whole, the centre of the

sensory system, and both sides of the body (e 5 *καὶ δὴ καὶ τὸ τῶν αἰσθήσεων πάθος κτλ.*). The object is to ensure that sensations from one lateral half of the body shall not go on independently of those from the other, and so to preserve the unity of the subject of sense-perception. The whole *λογιστικόν* is to be aware of what is e.g. within the range of either eye or ear. At e 6 *διάδηλον* is now known to be the reading of F as well as of Galen and the corrector of A, and this gives it superior authority as against the *διαδιδόμενον* of inferior MSS. The impossible *διαδιδόν* of A W Y would readily arise from a confusion of Λ and Δ; a 'correction' into *διαδιδόμενον* would then follow as a matter of course. Tr. 'that sensation from the parts on either side might be published to the whole body'. A creature like the chameleon is supposed to be able to be at once awake with one lateral half of the body and asleep with the other. The gods were anxious that this should not be so with man, but that sensations originating in either lateral half of his frame should serve as stimuli for appropriate reaction of the *whole* body. Timaeus is again following the medical science of his age. Cf. the famous description of the veins by Diogenes of Apollonia (Fr. 6, *Fr. d. Vors.*[3] i. 427, Aristot. *Historia Animal.* Γ. 511[b] 30 ff.), which opens with the words, 'the veins in man are arranged thus: there are two chief veins; they pass through the cavity of the body (*διὰ τῆς κοιλίας*) along the spinal column (*παρὰ τὴν νωτιαίαν ἄκανθαν*), one to the right [the *vena cava*], the other to the left [the aorta], each into the leg on the corresponding side, and upwards to the head past the collar-bone through the gullet. [D. then goes on to describe the minor *φλέβες* and resumes, Arist. op. cit. 512[a] 20.] Those which go to the head through the gullet are seen as large (*φαίνονται μεγάλαι*) in the neck; from the end of either many branch off to the head (*σχίζονται εἰς τὴν κεφαλήν*), those from the right going to the left and those from the left to the right (*αἱ μὲν ἐκ τῶν δεξιῶν εἰς τὰ ἀριστερά, αἱ δ' ἐκ τῶν ἀριστερῶν εἰς τὰ δεξιά*); both terminate against the ear (*τελευτῶσι δὲ παρὰ τὸ οὖς ἑκάτεραι*). What D. has in view here, I understand, is the course of the jugular veins, and T. seems to have the same facts before him in his description of the interlacing of the split ends of the two main 'veins'. Plato will be basing the statement on the account of Diogenes or a similar one. T. clearly assumes that it is along the *φλέβες* that the effects of stimulation of sense-organs pass to the brain. Here he is mistaken, though it is interesting to remember that it is the subdivision and decussation of the fibres of the optic *nerve* at the so-called optic *chiasmus* which ensures that in man the fields of vision of the two eyes shall overlap so nearly as they do; and that in general there is a 'complete crossing or decussation of efferent (voluntary) and afferent (sensory)' nervous paths 'between the brain and the peripheral organs'. (Huxley *Elementary Lessons in Physiology* xi, § 21). T. is also wrong about the supposed lashing of the head to the trunk, as Galen remarked in his commentary on the dialogue; 'elle y est assez liée par la colonne vertébrale, les muscles du cou, et les ligaments, les tendons et les aponévroses, qui attachent ces muscles d'une part aux vertèbres supérieures et aux épaules, d'autre part au bas du crâne' (Martin, n. clxv).

77 e 7—79 a 4. ***τὸ δ' ἐντεῦθεν ἤδη . . . ποιεῖ ῥεύματα.*** The detailed

account of respiration and circulation is made difficult to understand by the fact that Timaeus illustrates his meaning from the construction of a κύρτος or fish-trap. This would be familiar to Plato's readers, or at any rate they could easily inform themselves about it, but we have to discover what we can of the construction of a Greek fish-trap from T.'s own allusions, and his language is not free from ambiguities. Moreover, it is possible that Plato himself had no expert knowledge of the subject, so that one cannot be sure that a particular interpretation must be wrong if it can be shown, as C. W. says it can be in the case of A.-H.'s interpretation, that the trap 'would never catch a fish'. Perhaps T.'s trap would not actually catch any fishes either. There are two main interpretations of the details, that of Galen and that of Martin, Galen's being contained in the fragments of his commentary, and Martin's given in n. clxix of his edition (vol. ii, pp. 334–9).[1] A.-H. professes to follow Galen as against Martin, and this gives rise to a severe attack by C. W. on his treatment of this part of the dialogue (C. W., pp. 68–79). One main point of the attack, the allegation that A.-H. wrongly asserts that there is anything in the original Greek text of this part of Galen's commentary which is not equally to be got out of the Latin version of Gadaldinus on which M. had to depend, does not concern us. C. W.'s other contentions that Galen's view of the general structure of a κύρτος is wrong and M.'s right, and that the diagram of a κύρτος on p. 292 of A.-H.'s edition, is unconsciously adapted to M.'s theory and not to Galen's, are relevant. I do not think myself competent to have an opinion about the way to make a practical fish-trap. But the general outlines of the theory of respiration and circulation propounded can, as it seems to me, be fairly well made out from what T. says. I shall therefore attempt simply to discover his meaning by a careful examination of what he actually says about the physiological processes, and shall, as far as possible, avoid committing myself to assertions about the structure of κύρτοι. After all, as we have never seen a Greek κύρτος, we are more likely to be successful in discovering what it was like from T.'s comparison of it with the machinery of respiration as conceived by Empedocles, than to throw light on his views about this machinery by speculations about κύρτοι.

78 a 1. προδιομολογησάμενοι τὸ τοιόνδε. We are to start with a postulate assumed by agreement. We make a 'likely' ὑπόθεσις which we are not proposing to demonstrate. Our ὑπόθεσις is to be that a complex of small particles is impervious to larger ones (στέγει τὰ μείζω), but a complex of larger particles is pervious to smaller ones. The smaller can get in and out between the larger ones, but the larger cannot get in and out between the smaller. στέγειν, a 2, means to 'keep in' or to 'keep out' according to con-

[1] The fragments of Galen's commentary were first published in a Latin version by Gadaldinus in the Giunta edition of Galen in Latin produced at Venice in 1550. The version of Gadaldinus was afterwards reproduced in the complete Graeco-Latin edition of Galen by Chartier (Paris, 1679, Tom. V). Gadaldinus described his source as a Greek MS. which he had found in Italy. The Greek was apparently lost from his time until the same MS., or one copied from the same original, was rediscovered by Ch. Daremberg in what was then the Bibliothèque Royale of Paris. Daremberg issued the Greek text with a French version and valuable notes as *Fragments de Galien sur le Timée de Platon*, Paris 1848.

text. A roof στέγει, keeps out the rain, and that is why it is called a στέγη; a pail στέγει, keeps in, the water inside. Thus to give the precise sense of the verb we have to use an expression like 'to be impervious to'. What we postulate, then, is that the finer the particles of a complex, the smaller are the distances between adjacent particles. Then it follows from the smallness of the particles of fire that they can permeate any texture made of particles of air, water, and earth, or of compounds of them. Note that it is implied that there is κενόν, an empty interval, between the adjacent particles of any texture. If all motion were motion in a *plenum*, it would be absurd to begin a discussion with a postulate about the conditions of permeability.

78 a 6. καὶ περὶ τῆς παρ' ἡμῖν κοιλίας. We apply our postulate to the case of the human κοιλία, which here must be taken to mean not the 'belly', but the whole 'cavity' of the body (exactly as 'cavities' in various parts of the body, e. g. the ventricles of the brain, are called κοιλίαι by medical writers). It στέγει, keeps in, the food and drink it receives, but it is permeable by fire and πνεῦμα, air-currents. (Its walls are made of σάρξ and other compounds which contain the grosser 'roots', as we have already been told.) God therefore made use of fire and air, which can get in and out through the walls of the cavity, to ensure the 'irrigation' of the vascular system from the κοιλία, which is thus thought of as a central 'reservoir' or cistern. That is, he employed fire and air in the way which is just to be described, to bring about the process of respiration, and the object of respiration is to ensure the distribution of the blood formed by the digestion of our food through the φλέβες to the whole of the body. (The formation of this blood itself will be described in a subsequent section, 80 d 1 ff.)

78 b 3–7. πλέγμα . . . πλέγματος. What God did was this. (T. has, at an earlier stage, ascribed the making of the body and all that is mortal in us to the 'created gods', on the plea that τὸ θνητόν would not have been θνητόν at all if it had proceeded directly from the hands of the supreme God. Passages like the present show how far he is from meaning his polytheistic phrases to be taken *au pied de la lettre*.) He made a kind of net of fire and air like a κύρτος, a wicker pot or trap for catching fish. (We may think, if we like, of an eel-trap or a lobster-pot.) At its mouth (κατὰ τὴν εἴσοδον) this 'pot' has two ἐγκύρτια which open into it, and one of these ἐγκύρτια itself has a double outlet (διέπλεξεν δίκρουν). From the ἐγκύρτια he stretched a set of 'cords'—the διετείνατο shows that this rather than 'reeds' or 'rushes' is the meaning of σχοίνους in b 6—in every direction to the surface of the main κύρτος. He we find ourselves at once beset by uncertainties. The word ἐγκύρτιον seems to be known from no other source, so that its precise meaning is not independently fixed. But we have two clues to guide us. The derivation of the word shows that it means 'something which is in a κύρτος'. Galen also says in his commentary that ἐγκύρτια are structures within a κύρτος, of the same character as the whole but smaller. That is, they are 'pouches' within the main enclosure. Galen himself may be merely inferring this from the words of our text, but we can readily see that he cannot be far wrong. A κύρτος would be pretty sure

to have some such interior pouch or pouches in order to make the escape of a creature which had got into it difficult. We are not entitled to assume that the resemblance of the structure described by T. to a *κύρτος* goes further than this similarity in being a woven bag with another smaller bag of the same kind inside it, opening at the same outlet. There are two such 'pouches' in the present case, and we shall see directly that one of them, that which is itself 'bifurcated', is meant for the respiratory system with its two openings, the mouth and the nostrils, while the other stands, to put it loosely, for the digestive apparatus, which opens only by the *oesophagus* into the mouth. We are not to assume that there need have been any such complexity about an actual *κύρτος* intended to catch lobsters. The mere provision of one inner pouch would probably meet the fisherman's necessities. As for the *σχοῖνοι*, they pretty clearly stand for the whole system of blood-vessels running through the respiratory and digestive apparatus, so that there is, so far, no great obscurity about the thing symbolized. Galen is careful to tell us that nothing answering to the *σχοῖνοι* is to be found in a real fish-trap; Plato has put in the 'cords' as an imaginary counterpart of the vascular system in the human body. (Daremberg, p. 22 *τούτου τὸ ἀνάλογον οὐκέτι κατὰ τοὺς τῶν ἁλιέων ἐστὶ κύρτους· ἀπὸ τῶν ἐγκυρτίων γὰρ πρὸς τὸ τοῦ περιέχοντος κύκλου πλέγμα σχοῖνος οὐδεμία διήκει, κενοῦ τοῦ μεταξὺ παντὸς ὄντος· ἐν ἡμῖν δὲ διήκουσιν ἔκ τε τῆς κοιλίας καὶ τοῦ πνεύμονος εἰς ἅπαν τὸ σῶμα μέχρι τῶν ἐσχάτων αὐτοῦ περάτων ἐκτὸς ἀρτηρίαι καὶ φλέβες, ἃς εἰκάζει σχοίνοις ἀπὸ τῶν ἐγκυρτίων ἐπὶ τὸν κύρτον ἐκτεινομέναις.)

78 b 7–c 2. *τὰ μὲν οὖν ἔνδον . . . ἀεροειδῆ.* Next we are told that *ἅπαντα τὰ ἔνδον τοῦ πλοκάνου* are made of fire, but the pouches (*ἐγκύρτια*) and their containing envelope (*τὸ κύτος*) are of air. Here the serious divergences of interpretation begin. Exactly what are the *ἅπαντα τὰ ἔνδον τοῦ πλοκάνου*? St.'s view is that the whole *πλέγμα* of *κύρτος* and *ἐγκύρτια* means simply the lungs, *oesophagus* and *trachea*, and that the *ἔνδον τοῦ πλοκάνου* means the interior of the lungs. M. says that the *intérieur de la masse* is 'l'espace occupé par la substance même du corps'; A.-H. has a theory derived from Daremberg, that what is meant is the 'inner coat' of the *κύρτος*, i.e. that the *κύρτος* has two layers or folds, and that the inner of these is made of fire, the outer of air. This last view seems to me, as to C. W., to be wrong, since there is not a word in the text to suggest that the 'envelope' has more layers than one. St., I presume, means us to construe the genitive *τοῦ πλοκάνου* as partitive, 'all that part of the *πλόκανον* which is within'. To this there seem to be two objections. As a mere point of grammar, it is almost impossible to separate *τοῦ πλοκάνου* from *ἔνδον*, and if the genitive depends on *ἔνδον*, the words cannot well mean anything but 'the *contents* of the *πλόκανον*, just as *τὰ ἔνδον τῆς οἰκίας* would naturally mean not 'the inner surface of the house' but 'what is inside the house'. Also it seems to me that St., and some recent translators who adopt his view, are wrong in supposing that the *πλόκανον* is meant for the lungs, gullet, and windpipe. I agree with M. (and A.-H.) in holding that the *πλέγμα* must be rather differently interpreted in the light of the Empedoclean theory. At the same time I do not think M.'s interpretation, as distinct from his translation, really

expresses what T. means to say. My own interpretation will appear in the sequel. At present we are concerned simply with the question of rendering, and must, as I believe, be content to take it as certain that the network of both the main *κύρτος* and its *ἐγκύρτια* is made of air, the contents of the 'envelope' of fire.

78 c 2–3. καὶ λαβὼν αὐτὸ . . . τρόπον τοιόνδε. The *ζῷον* is supposed to be already formed (*τῷ πλασθέντι ζῴῳ*). This seems a good reason for not identifying the *κύρτος* which is now to be 'put round' it with the lungs or any other part of our anatomy. We can hardly suppose that T. would regard the *ζῷον* as already *πλασθέν* if it had yet to have the lungs put into it, not to mention that we have been told of their formation a good while ago.[1] As a further point, *περιέστησε* might mean 'put round on the inside', but where there is nothing in the context to suggest this interpretation is much more naturally understood to mean 'put round on the outside', and it would also be a strange way of speaking to talk of the lungs as though the interior of the thorax were 'coated' with them, as the walls of a room may be coated on the inside with paint or wall-paper.

78 c 3. τὸ μὲν τῶν ἐγκυρτίων. Here M. certainly went wrong on a point of Greek, and the error has infected his whole conception of the *κύρτος* and its pouches. He took *τὸ μὲν τῶν ἐγκ.* to mean 'one of the pouches' (the genitive being partitive), whereas it clearly means simply 'the pouch-contrivance', the *τὸ δέ* of c 5 *infra* being antithetical not to *τὸ μέν* but to the *θάτερον* of the same line. A.-H. is wrong in saying that we are to supply *πλόκανον* with *τὸ μέν*. St. has explained correctly; *τὸ τῶν ἐγκυρτίων per periphrasin dictum pro τὰ ἐγκύρτια.* 'The pouch-affair he inserted into the mouth.'

78 c 4. διπλοῦ δὲ ὄντος αὐτοῦ. Sc. *τοῦ τῶν ἐγκυρτίων*, 'and as this contrivance had two parts', referring to the former statement that there are two *ἐγκύρτια*. M.'s mistake about the *τὸ μέν* in the preceding line led him further astray into supposing that one of the two pouches is itself double. We must be careful to avoid following him in this slip.

78 c 4–5. κατὰ μὲν . . . θάτερον, 'he let the one (*θάτερον*) down into the lungs by way of the windpipe'. *ἀρτηρίας* is plural apparently because of the way the trachea spreads out into the bronchial tubes to right and left. Note again that the *πλεύμων* is spoken of as already there when the 'pouch' is inserted. This *ἐγκύρτιον* is, of course, the respiratory one.

78 c 5–6. τὸ δ' εἰς τὴν κοιλίαν παρὰ τὰς ἀρτηρίας, 'but the other into the belly alongside the windpipe', i.e. by way of the oesophagus or gullet. This is the *ἐγκύρτιον* which is directly connected with digestion.

[1] The order of exposition is logically determined by the fact that the whole double process of respiration and circulation is regarded as subservient to the digestion of *τροφή*. Hence we have first the account of the human frame, then the mention of the vegetation which was its original *τροφή*, and only in the third place the description of the complicated processes by which the concoction of *τροφή* is ensured. It is a consequence of this arrangement that nothing was said about blood in the section describing the making of *σάρξ*, *νεῦρα*, and other constituents of the body. The account of the composition of *αἷμα* is deferred until we come to the theory of the way in which the supply of it is kept up.

78 c 6–d 1. τὸ δ' ἕτερον . . . ἀναπληροῦσθαι. 'The other he split and allowed both parts of it in common an outlet by the channels of the nose, so that when the one part was not working by way of the mouth, all its currents too might be replenished from that source' (i.e. from the opening provided in the nostrils). *τὸ ἕτερον* must mean the same thing as the preceding *θάτερον*, the first-named pouch, which has a double entrance. The entrance to the bag let down into the lungs was made double, and both its necks were further given a common discharge through the nostrils. This implies that not only do the lungs communicate with the nostrils as well as with the mouth, but that there is a further communication between nostrils and palate; hence we can not only breathe in and out through the nose as well as through the mouth, but besides this, air which is coming out at the mouth may, if that exit is closed, get out at the nostrils. The object of this communication is that we may be able to breathe freely even when the mouth is e.g. occupied in eating and drinking. The clause *τὸ μέρος . . . κοινόν* is inserted because it is not the fact that we can only expel through the nostrils air which has entered that way. The exit by the nostrils is a 'common' one for air which has been inhaled in either way. The *θάτερον* of c 8, as we see from the context, has nothing to do with the previous uses of *θάτερον* in the sentence. It means one of the two exits which have been now provided for that *ἐγκύρτιον* which was formerly spoken of as *θάτερον*.

78 d 1–4. τὸ δὲ ἄλλο κύτος . . . ἐποίησεν. 'The envelope in general', as contrasted with the *ἐγκύρτια*. 'He made the envelope of the *κύρτος* in general grow round all the hollow part of our body.' *περιέφυσεν*, like *περιέστησεν*, could only naturally be said of something which 'grows round' from outside, as the bark, e.g. does round a tree; and as we see immediately below in d 5, the *πλέγμα*, which is identical with the *κύτος*, is expressly said to move alternately into and out of the body. Thus its *original* position is plainly immediately outside the body, though its *ἐγκύρτια* or pouches are made to go down into the lungs and belly. Also we have been told that the *πλέγμα* is made of air. Here it is clear that those who suppose the *κύρτος* to be the lungs and their connexions cannot be right. The air immediately outside the hollow trunk of the body and contiguous with it must be what is meant by the network of the fish-trap; the statements made about this network admit of no other coherent interpretation. This was nearly the view taken by Galen. Galen's words (Dar. 24), which are given as a comment on 78 b 7–c 2 *τὰ μὲν οὖν . . . ἀεροειδῆ*, are as follows: *τοῦ πλοκάνου λέγει νῦν ὅλου τοῦ τῷ κύρτῳ παραπλησίου, ἐπειδὴ ἔστιν ἔνδον αὐτοῦ καὶ τὰ ἐγκύρτια, βούλεται δὲ τὴν περιεχομένην ὑπὸ τούτων χώραν ἀεροειδῆ μᾶλλον ὑπάρχειν ἢ πυροειδῆ· διὰ τοῦτο προσέθηκε τῷ περὶ τοῦ παντὸς πλοκάνου λόγῳ "τὰ ἐγκύρτια . . . ἀεροειδῆ". τὰ μὲν οὖν ἐγκύρτια προδήλως ἐστὶ τοιαῦτα· κενὴ γὰρ χώρα μόνον ἀέρα περιέχουσα κατὰ τὸν θώρακα φαίνεται, τὸ δὲ κύτος οὐκέτι πρόδηλον ὅπερ (in marg. ὅπως) ἀεροειδὲς εἴρηται· δοκεῖ γὰρ ἐκ τοῦ κύτος ὀνόματος ὡς ἓν σημαίνεσθαι (marg.; MS. in text. ἐνσημαίνεσθαι) τὸ σῶμα περὶ οὗπερ ἂν ὁ λόγος γένηται, φαίνεται δὲ μάχεσθαι τοῦτο τοῖς προειρημένοις, εἴ γε τὸ σύμπαν κύτος τοῦ κύρτου συμπληροῦται διά τε τῶν ἐγκυρτίων καὶ τοῦ μεταξὺ παντὸς . . . καταλίποιτο ἂν οὖν νοεῖν ἡμᾶς τὸ κύτος τοῦ κύρτου λεγόμενον αὐτῷ τὸ ἔξωθεν*

αὐτοῦ πλέγμα· τοῦτο γάρ ἐστι τὸ τὴν οὐσίαν ὅλην τοῦ κύρτου συνιστάνον· ὥσπερ οὖν τὸ μεταξὺ τούτου τε καὶ τῶν ἐγκυρτίων ἐνοοῦμεν ὑπὸ πυρὸς ἐπικρατούμενον, οὕτως ὑπ' ἀέρος ἐπικρατεῖσθαι χρὴ νοῆσαι τὸ ἔξωθεν αὐτοῦ πέρας, ὅπερ ἐστὶν αὐτὸ τὸ κύτος τοῦ σπλάγχνου, τοῦτο δ' ἂν ἐν ἡμῖν εἴη τὸ δέρμα, ψυχρὸν ὑπάρχον ὡς τὰ περιεχόμενα . . . (here follows a small lacuna in the text) τοῦτο (MS. τούτῳ) συνεχὲς τῷ πέριξ ἀέρι· καί μοι δοκεῖ βούλεσθαι δηλοῦν τὸν περικείμενον ἀέρα τὸν ψαύοντα τοῦ πλοκάνου μέρος τι καὶ αὐτὸν εἶναι τοῦ κύρτου. Galen's explanation, followed by Daremberg, seems to me right in spite of the fact that C. W. (p. 78) calls it 'peculiar' and apparently rejects it, though without any indication of his own interpretation. Those to whom the conception seems paradoxical are apparently only surprised by it because they forget the peculiar theory of Empedocles which the whole picture presupposes. Galen approves of the view that air and fire are the instruments which effect digestion and circulation, but objects to the description of the πλέγμα, on the ground that he dislikes the notion of an atomic or granulated structure of matter; *de Hippocratis et Platonis placitis* viii. 712 (Kühn 706) τὸ μὲν οὖν ἀέρα καὶ πυρὶ χρῆσθαι τὴν φύσιν πρὸς πέψιν τροφῆς αἱμάτωσίν τε καὶ ἀνάδοσιν ὀρθῶς εἴρηται· τὸ δὲ ἐξ αὐτῶν πλέγμα γεγονέναι καὶ μὴ διὰ ὅλων κρᾶσιν οὐκέτι ἐπαινῶ, καθάπερ οὐδὲ τὸ πῦρ ὀνομάζειν αὐτόν, ἐνόν, ὥσπερ Ἱπποκράτης, ἔμφυτον θερμόν. The contents of the πλόκανον will thus not be exactly, as M. says, the space occupied by the solid mass of the body, but the fire which lies within the envelope of air contiguous with the mass of the body. Apart from this his view of what was meant by the πλόκανον and τὰ ἔνδον τοῦ πλοκάνου will be correct.

78 d 2–4. καὶ πᾶν δὴ τοῦτο . . . ἐποίησεν. A.-H. seems to me to misunderstand this clause and consequently to miss both the fundamental agreement of the theory with that of Empedocles and the point of Aristotle's criticism of it. He translates ἅτε ἀέρα ὄντα, 'because it (sc. πᾶν τοῦτο) is air'. This implies that ὄντα is accus. masc. sing. and refers to τοῦτο, being attracted from the neuter ὄν into agreement with the gender of the complement ἀέρα. The context demand that ὄντα shall be neuter pl. referring to τὰ ἐγκύρτια, 'because *they* are air'. πᾶν τοῦτο flows into the pouches without difficulty because they are made of air. The 'envelope' itself is air too, and its contents are fire. Thus there is nothing to prevent the air of which the 'envelope' is made, and *a fortiori* nothing to prevent the fire within it, from permeating the ἐγκύρτια. Consequently, we are free to suppose that the 'envelope' and its contents are periodically drawn into the pouches. Hence M. seems to me substantially right when he translates, 'he caused all the fire contained in this envelope to flow gently into the pouches of air'. The important point, then, is that the initial step in the process which is being described is not 'inhaling' air through the respiratory passages but the entrance of a complex of fire and air into the body through the πόροι generally, with the result that air gets into the two ἐγκύρτια. As we proceed we shall see that this leads, in the second place, to expiration through the respiratory passages, and that inspiration only comes in at a third stage. This is in accord with the doctrine of Empedocles, and explains Aristotle's objection that Plato mistakenly made ἐκπνοή, 'expulsion of air', precede εἰσπνοή, 'inhalation'.

78 d 4–e 2. τοτὲ δὲ . . . γιγνόμενον. 'And in alternation he made the pouches flow the other way, the network passing readily in and out through the body, because of its (the body's) rarity, the rays of fire which stretch through the interior (of the network) following the motion of the air in either direction; this process he caused to go on without respite so long as the mortal creature holds together.'

78 e 2–3. It is to this alternate rhythmical process that the 'giver of names' has assigned the names ἀναπνοή and ἐκπνοή. When we compare the use of these words with the technical meaning assigned to them in e.g. Aristotle, we note two points of difference. Both the in- and the out-breathing are supposed to take place all over the body; we have not yet come to any mention of the inhalation or exhalation of air by the passages of nostrils and mouth, and secondly ἀναπνοή, which in Aristotle is the generic name for both breathing in and breathing out, is clearly being used here, like Aristotle's more exact εἰσπνοή, for one of the antithetical processes, the reception of air into the body. When we come to deal with Aristotle's criticism, we shall have to bear in mind that he is throughout using words in his own technical sense. When he says that Timaeus makes ἐκπνοή precede εἰσπνοή, he means that expiration of air from mouth or nostrils is treated as an earlier stage in the complete process, of which we have so far considered only the initial stage, than inhalation, and this statement we shall find to be correct. If Aristotle, like Timaeus, were using the word 'breathing' to mean reception of air or expulsion of air by *any* channel whatever, his criticism would be inaccurate.

The general idea, then, is this, if we leave out of consideration questions about the precise construction of the fish-traps which Timaeus uses as an illustration. First the main κύτος or envelope of air with its contained fire is drawn into the hollow of the body, through the πόροι all over the surface of this hollow, which, as he is careful to remind us, is μανόν, i.e. porous, everywhere. The contained fire moves in, not because fire could not escape through the meshes of a covering of air—we have been expressly told that it can—but because the motion of the particles of the containing κύτος is communicated to those of the contained fire. The first step, then, is that air carrying fire with it, gets into the body without being 'inhaled', and makes its way into the 'pouches' in the lungs and κοιλία. Next, the pouches, being now charged with all this air, overflow, and there is a current setting the other way. The 'envelope' is driven out again. So far the apparatus of the lungs has had no inhaling or exhaling to do, and if the whole process were a simple alternation of the kind described, there would be no reason why the mouth and nostrils should play any part in respiration. But in real fact the complete rhythm is a more complicated affair, and we shall directly see why.

The process, so far as it has as yet been described, becomes clearer by comparison with the well-known lines in which Empedocles accounts at once for the rhythm of breathing and for the circulation of the blood on the analogy of the working of a water-clock (κλεψύδρα). The κλεψύδρα was a metal vessel with a narrow funnel and a broad top perforated with holes. In use it was set up with the funnel downwards and unstopped, so that the water dripped out slowly and uniformly, and its flow could be

used, like that of the sand in an hour-glass, to measure intervals of time. To fill it you invert it into the water, with the perforated disk downwards, taking care to leave the funnel open, so that the air in the vessel can escape. If you keep the funnel stopped up, the air does not escape, and the water will not rise into the clock. In the same way, Empedocles says (Fr. 100, *EGPh.*[3] 219), 'this is how all things draw in breath and give it out again: all have bloodless tubes of flesh stretched over the surface of their bodies', and at the mouths of these tubes the skin is perforated with closely set *πόροι*, so as to keep in the blood while a free passage is afforded to the air. 'When the blood recedes from these pores air rushes in, just as the water rushes through the holes of the disk of the water-clock when the air is allowed to escape by the funnel, and when the blood surges back again the air is expelled' (*ὧδε δ' ἀναπνεῖ πάντα καὶ ἐκπνεῖ· πᾶσι λίφαιμοι | σαρκῶν σύριγγες πύματον κατὰ σῶμα τέτανται, | καί σφιν ἐπὶ στομίοις πυκιναῖς τέτρηνται ἄλοξιν | ῥινῶν ἔσχατα τέρθρα διαμπερές, ὥστε φόνον μὲν* (sc. the blood) *| κεύθειν, αἰθερι δ' εὐπορίην διόδοισι τετμῆσθαι. | ἔνθεν ἔπειθ' ὁπόταν μὲν ἀπαίξῃ τέρεν αἷμα, | αἰθὴρ παφλάζων καταΐσσεται οἴδματα μάργῳ, | εὖτε δ' ἀναθρῴσκῃ, πάλιν ἐκπνέει, ὥσπερ ὅταν παῖς | κλεψύδρῃ παίζῃσι διειπετέος χαλκοῖο . . .* (the simile is then developed at length, and E. finally resumes) *ὣς δ' αὖτως τέρεν αἷμα κλαδασσόμενον διὰ γυίων | ὁππότε μὲν παλίνορσον ἀπαίξειε μυχόνδε, | αἰθέρος εὐθὺς ῥεῦμα κατέρχεται οἴδματι θῦον, | εὖτε δ' ἀναθρῴσκῃ, πάλιν ἐκπνέει ἶσον ὀπίσσω*). Timaeus is plainly following this account, as he adopts its two fundamental points: (1) Air, in the first instance, enters the body through the pores of the skin generally. The mouth and nostrils first come into play in connexion with the expulsion of air which has got into the body, and this is why Aristotle objects to the whole theory, and again why Galen says (*de Hippocratis et Platonis placitis* viii. 714 [Kühn 708]) that the theory is rather one of *διαπνοή*, transpiration, than of *ἀναπνοή*, respiration, and is consequently faulty because it neglects the fundamental fact of *ὁλκή*, attraction. That is, it overlooks the point that the air breathed is actually *drawn* in, for the thorax, when distended (op. cit. 715, Kühn 708) *ἕλκει διὰ τῆς τραχείας ἀρτηρίας ἀναγκαίως εἰς τὸ στόμα τὸν ἔξωθεν ἀέρα.* (2) It follows that E. makes breathing and the circulation of the blood parts of one complex process. T. has already hinted his intention of doing the same thing, by opening the account of respiration at 77 c 9 by an account of the construction of the vascular system for the 'irrigation' of the body, and he subsequently goes on to work out the details on the same lines. As Bt. says of Empedocles' theory (*Greek Philosophy*, Pt. I, *Thales to Plato* 73), the process is made thus to correspond exactly with that rhythmical alternation of *φιλία* and *νεῖκος* by which Empedocles accounts for the phases in the life of the *οὐρανός* at large, air playing the part of *νεῖκος* and blood that of *φιλία*. Of course, the close similarity of T.'s theory with that of E. is no accident; it is explained by the two facts that E. was very much under Pythagorean influences and that T. is one of the Pythagoreans who were adherents of the Sicilian biology and medicine.

78 e 3—79 a 4. *πᾶν δὲ δὴ . . . ῥεύματα.* 'This whole action and passion has come to be for our body being nourished and living by means

of moisture and refrigeration. For when the fire within (sc. within the *κύτος*), in virtue of its connexion (*συνημμένον*), follows the movement of the current of breath in and out, and from time to time enters the body with a surge and lays hold of the food and drink, of course (*δή*) it melts them and divides them into small portions, driving them (*διάγον*) through the exits in the direction of its advance, and pumping them into the veins like water from a fountain into runnels, and so makes the currents of the veins run through the aqueduct (*αὐλών*) of the body.' The last words give the *raison d'être* of the process. Respiration is regarded as a means of bringing heat—'fire', as T. calls it—to bear on the contents of the *κοιλία*, and thus producing *πέψις*, the digestion or concoction by which food taken in at the mouth is converted into blood. The process is, says T., keeping up the metaphor with which he had started, exactly what the proper irrigation of a kitchen-garden is to the growth of the kitchen-stuff. It is implied that, but for the part played by the currents of air in bringing the right amount of heat and no more to bear on the victuals in all regions of the *κοιλία*, we should not need to breathe. The heat or fire, it must be remembered, is in the interior of the *κύρτος*, which sways in and out of the trunk; i.e. it is really the body's *ἔμφυτον θερμόν* or vital heat, but on the *ὑπόθεσις* that fire can pass through the interstices between the particles of all other bodies, this heat is thought of as itself due to particles of fire coming from without, and regularly brought into the body in fresh supplies through the pores along with the currents of air. The theory will look less fantastic if we remind ourselves that as late as 1841, when M. published his commentary, heat was still supposed to be a property of a special stuff, 'caloric', so that T.'s device may be said to be one for keeping the interior of the body continually supplied with an adequate and equably distributed quantity of 'caloric'.

78 e 4. τό τ' ἔργον καὶ τὸ πάθος. The process is *actio* or *passio* according to the point of view from which you look at it. From the point of view of the currents of air and fire it is an *ἔργον*; from that of our body, upon which they play, it is a *πάθος*.

78 e 5. ἀρδομένῳ καὶ ἀναψυχομένῳ. The 'refrigeration' is due to the fact that air as well as fire is entering the body. The air brings in the fire which keeps up the vital heat, but the constant alternation of the rhythm of the process is all the time introducing cooler air into the body in the place of that which leaves it, and thus we escape being over-heated. The 'moistening' is the effect of the circulation of the blood. T. is thinking in terms of the garden metaphor again, and remembering the necessity of wind as well as water for the green stuff.

78 e 6. εἴσω καὶ ἔξω τῆς ἀναπνοῆς ἰούσης. Here, as again in 79 a 5 and elsewhere, *ἀναπνοή* is being used as the generic term 'respiration', which includes both *εἰσπνοή* and *ἐκπνοή* as its species. Cf. Galen's remark (*Comment.* ed. Daremberg, p. 28) on the established terminology of medicine: *ὄντων γὰρ τριῶν πραγμάτων, ἑνὸς μὲν τῆς εἴσω φορᾶς, δευτέρου δὲ τῆς ἔξω, καὶ τρίτου ἐξ ἀμφοῖν συγκειμένου, τὴν μὲν ἔσω φορὰν τοῦ πνεύματος εἰσπνοὴν ὀνομάζουσι, τὴν δ' ἔξω φορὰν ἐκπνοήν, τὸ δ' ἐξ ἀμφοῖν σύνθετον ἀναπνοήν.*

ib. **συνημμένον.** This explains why the fire does not simply slip

through the network of air and so fail to enter the body at all. So far as our ὑπόθεσις about the permeability of all grosser structures by fire goes, this might happen. But just because the particles of the contained fire are so minute, the motion of the air will be readily communicated to them, and they will be carried along with it.

78 e 7. διαιωρούμενον of F and A^2 gives just the right sense, 'swinging up and down'. The current of air 'surges' like a wave of the sea. Cf. the curious theory worked out in the *Phaedo* (111 e ff.) about the αἰώρα or 'see-sawing' of the rivers of the underworld. The rival reading διαιρούμενον (A Y) must be a corruption, as it yields an impossible sense. On T.'s corpuscular theory, the particles of fire, being the smallest of all and having the sharpest angles, cannot be 'divided' by anything.

79 a 2. διὰ τῶν ἐξόδων. The 'exits' here must not be confused with the mouths of the ἐγκύρτια. We have not yet reached the point where these come into play. We are still dealing with air which is supposed to make its way in and out through the walls of the trunk. The διέξοδοι are the 'pores' of Empedocles which are found all over the skin. The fire which has got into the body is now moving backwards towards the entrances at which it came in, and drives the τροφή which it has been melting and cutting up, in fact converting into blood, as will shortly be explained, along the 'channels' in the direction of its own motion. T. is accounting for the movement of blood in the arteries exactly in the fashion of Empedocles.

79 a 5–e 9. πάλιν δὲ . . . παρέχεται. We have yet to explain how the entrance of air and fire through the walls of the chest and belly sets up the alternate rhythm of inhalation and exhalation by mouth and nose. This is what is dealt with in the present section of the discourse. It will be found, I believe, that the theory of Timaeus is really incoherent, but that the incoherency is capable of a simple historical explanation. He is attempting to expound the doctrine of Empedocles, and this doctrine is itself incoherent and moreover will not really fit in with the physical principles of the earlier part of the discourse, which came direct from Pythagoreanism. The immediate point to be explained is this. So far as we have gone, there seems no need whatever for the provision of the respiratory passages through the mouth and nostrils. What has been described is a sort of tidal flux and reflux of the air into and out of the body through the 'pores' in the skin. It has not been said in so many words whether the air which has got into the system makes its escape by the same way by which it came in or not, but that it can do so has been implied as the natural meaning of such a phrase as εἴσω καὶ ἔξω τῆς ἀναπνοῆς ἰούσης, 78 e 6, and the ἀκολουθεῖν ἐφ' ἑκάτερα ἰόντος τοῦ ἀέρος of 78 d 7. But the fact that whether or not air enters the body through the whole skin, it certainly both enters and leaves it through the respiratory passages is too manifest to be ignored, and some explanation of this has to be supplied. The explanation given by Timaeus falls into two parts. From 79 a 5 to 79 c 7 is concerned with explaining the mechanics of the process. The rest of the passage, 79 c 7–e 9, is concerned with the physiology of it. The two halves of the exposition call for separate treatment.

First as to the purely mechanical question. There are two separate points to be explained, (*a*) why the mouth and nostrils should come into play at all, and (*b*) why they serve not only for one half of the complete process, the expulsion of air, but for the other half, its admission as well. It is to clear up this latter point that the physiological statement of 79 c 7 ff. is added.

Timaeus begins by introducing us to a curious mechanical theory of which he afterwards goes on to make an extended use, that of motion of *περίωσις*, or as Aristotle and later writers commonly call it, *ἀναπερίστασις*. The conception is of first-rate importance for any physical theory which, like those of Empedocles, Aristotle, the Stoics, absolutely denies the existence of *κενόν* in *rerum natura*. Such theories can only account for motion on the analogy of the motions which take place in a perfect fluid. Views of this kind go back to Empedocles, on whom they were forced by the assumption that Parmenides had been right in holding that *What is* is a *plenum*, but that this principle must somehow be reconciled with the further consideration that motion, being revealed to us by our senses, is an undeniable fact. The doctrine of *περίωσις* is a direct consequence of the combination of these two assumptions. If *What is* is a *plenum*, there can still be motion, provided that when any constituent of it moves, its place is taken at once by something else. This can only happen in a bounded plenum on two conditions. (*a*) The movement must be instantaneous, and (*b*) it must be cyclical. The movement of *A* must extrude *B* which extrudes *C* . . . and so on, and thus any advance of *A* must ultimately involve, as a consequence of this series of impulsions itself a movement of something *X* from 'behind' *A* into the place which *A* has vacated. *περίωσις* or *ἀντιπερίστασις* is the motion which satisfies these two conditions of being strictly instantaneous and of being a 'circular' process. T. starts then from this position. It is interesting to note that this conception of a strictly instantaneous cyclical motion continued to play a part in natural philosophy down to the latter half of the seventeenth century, when Boyle's experiments with the air-pump led to the revival of the old conception of a *κενόν*. It is central, for example, in the speculations of Hobbes. Cf. *Concerning Body* c. 22, § 12 (Molesworth, i. 344), 'For of two parts of a hard body, when that which is foremost drives before it the medium in which the motion is made, at the same time that which is thrust forward thrusteth the next, and this again the next, and so on successively. In which action, if we suppose that there is no place void, it must needs be, that by continual pulsion, namely, when that action has gone round, the movent will be behind that part, which at the first seemed not to be thrust forwards, but to be drawn; so that now the body, which was drawn, goes before the body which gives it motion, and its motion is no longer traction, but pulsion'. Ib. c. 25, § 3 (Molesworth, i. 392), 'For in all motion which proceeds by perpetual propagation, the first part being moved moves the second, the second the third, and so on to the last, and that to any distance, how great soever. And in what point of time the first or foremost part proceeded to the place of the second, which is thrust on, in the same point of time the last save one proceeded into the place of the last yielding part; which, by reaction, in the same instant, if the reaction be strong enough, makes a phantasm'.

79 a 6. οἱόνπερ τὰ νῦν ἐστιν. That is, T. recognizes that the account given so far does not describe the existing facts. It would suggest that air simply surges in and out of the body through the pores of the skin, with the 'swaying' in and out of the πλέγμα. But, 'as a fact', air also comes in and out at mouth and nostrils.

79 b 1–c 1. ἐπειδὴ . . . μηδὲν εἶναι. The general theory of περίωσις. Since there is no 'void', when air is driven out of the body it does not issue into a vacuum. It is not quite clear whether T. means to say that there is no κενόν in nature at all, or that there is none sufficient to receive the extruded air. The emphasis laid on the principle would suggest that he means the words to be taken in the strictest possible sense. In that case he is actually contradicting the presuppositions of his own earlier physical theories. But the reality of κενά is just the point of all others on which it ought to be most glaringly impossible to make a synthesis of Pythagoras and Empedocles, since Empedocles maintains that there is no κενόν and Pythagoreanism asserts that there is κενόν which διορίζει τὰς φύσεις. (For the view of Empedocles see Aristotle *de Caelo* Δ. 309ª 19 ἔνιοι μὲν οὖν τῶν μὴ φασκόντων εἶναι κενὸν . . . οἷον . . . Ἐμπεδοκλῆς, Theophrastus *de Sensu* 13, *Doxogr. Graec.* 503, where it is urged as a difficulty against E. πότερον οἱ πόροι κενοὶ ἢ πλήρεις; εἰ μὲν γὰρ κενοι, συμβαίνει διαφωνεῖν ἑαυτῷ, φησὶ γὰρ ὅλως οὐκ εἶναι κενόν, Empedocl. Fr. 13 οὐδέ τι τοῦ παντὸς κενεὸν πέλει οὐδὲ περισσόν.) Pythagoreans who, like Philolaus, were trying to incorporate Empedoclean biology into their own system were absolutely bound to fall into contradictions on this point.

It follows then that the extruded air gives an impulse to contiguous air which, in turn, passes the impulse on (τὸ ὠθούμενον ἐξελαύνει τὸ πλησίον ἀεί) and, as *there is no void*, the result must in the end be that air from without is driven round, by a circular process (περίωσις), into the body, as though by the revolution of a wheel (οἷον τροχοῦ περιαγομένου), *because there is no void.* (The apparently unnecessary repetition is due, I believe, to the fact that *Plato* means to call our attention to the very point that the assumption is inconsistent with the earlier molecular physics of the dialogue. He is determined that we shall not forget that the denial of the reality of τὸ κενόν is the *sole* reason for insisting on περίωσις.) Also, for the same reason, the process must be instantaneous (ἅμα πᾶν). (We are meant to understand the full paradoxicality of the consequences of denying τὸ κενόν.)

79 c 2–4. διὸ δὴ τὸ τῶν στηθῶν . . . πλῆρες. As the following clause shows, the dismissal of breath referred to is supposed to be through mouth or nostrils, and this is the first reference to them we have had. The air which has come in at the pores of the skin is pushed from behind by further supplies of air coming in in the same way, and so forced towards the mouth of the respiratory ἐγκύρτιον, and naturally escapes there because there is an opening for it to get out at. This explains why air which has been taken in at the pores gets out at the respiratory outlets, i. e. why mouth and nostrils are used for expiration. As the original account introduced air into the body through the pores, we see why Aristotle complains that the theory makes ἐκπνοή precede εἰσπνοή. A new-born infant's first respiratory act should be to *expel* at mouth or

nostrils the air which has got in through the surface of the skin, but this is not what really happens. The *tense* of *μεθιέν* must be noted. Since 'there is no *κενόν*' the chest or lung *μεθιὲν τὸ πνεῦμα πάλιν γίγνεται πλῆρες*, 'fills again in the act of letting the breath escape'. The instantaneousness belongs to the conception of *περίωσις*. Cf. the so-called *Timaeus Locrus* (101 d—102 a).

79 c 5–7. αὖθις . . . δίοδον. So far as the account has gone, the 'wheel' might revolve always in the same direction and always 'come full circle'. We might always inhale through the skin and exhale through mouth and nostrils. This we know not to be the case. In actual fact, the 'wheel' revolves in both senses; we breathe in as well as out by mouth and nostrils, and, as Timaeus assumes, out as well as in through the pores of the skin. Hence T. adds to his first statement the further explanation that 'on the other side' (*αὖθις*) when the air goes out through the body it 'pushes respiration round' (*περιωθεῖ τὴν ἀναπνοήν*) to the passages of the mouth and nostrils. In c 6 *ἀναπνοή seems* to stand not for the whole double process of inhaling and exhaling but for one half of it, that called by *ἰατροὶ εἰσπνοή*, the reception of air from without. The immediate effect of *περίωσις* would be that the escape of air at mouth and nostrils forces in fresh air by the other entrance at the pores of the skin, or the escape of air at these pores forces in fresh air by way of the mouth and nostrils. T. has thus described (*a*) the entrance and exit of air *διὰ τοῦ σώματος*, 78 d–e, (*b*) the expulsion of it by the special respiratory passages, 79 b–c 4, (*c*) the entrance of air through these passages, 79 c 5–7. We see now that the picture suggested in 78 e was too simple to fit the facts. The air escaping from the body does not merely ebb like the sea, for 'there is no void'. The wheel takes a turn in one direction and then in the other, and this complicates the process. Air comes in and goes out by both channels; it does not simply come in through the skin and then escape at nose and mouth. Why there is this swaying of the 'wheel' to and fro is to be explained by the passage which immediately follows. It cannot be said that the explanation is as unambiguous as we could wish. We should probably be in a better position to understand the whole matter if only the complete account of respiration given by Empedocles had survived. Unfortunately nothing has been left to show how E. worked the mouth and nostrils into his account.

79 c 7–d 5. τὴν δ' αἰτίαν . . . ἀέρος. Hitherto we have been concerned with the mechanism of the respiratory process, we have not been told anything of its efficient cause. *Why* the *πλέγμα* of 78 d 5 alternately swings in and out of the body has so far been left unexplained. As Galen (Daremb. p. 30) says, commenting on the section 79 a 5–c 7 *οὐδὲ κατὰ ταύτην τὴν ῥῆσιν εἶπεν ἤδη τὴν πρώτην αἰτίαν τῆς ἀναπνοῆς, (ἀλλ') ἀμέλει συμπληρώσας αὐτήν* (sc. *τὴν ῥῆσιν*), *ἄρχεται τῆς μετ' αὐτὴν ὧδε· "τὴν δ' αἰτίαν . . . θετέον τήνδε"*. What starts the process we are now to learn. We are told in fact that the primary cause of the whole complex process is the vital or animal heat which is always present in a living organism. This is, no doubt, meant to explain why respiration goes on as long as ever life remains in the body and no longer. There is a certain verbal difficulty about the sentence. What T. is actually going to

'explain' is the alternation of the reception and expulsion of air through the πόροι in the skin with its expulsion and reception at mouth and nostrils. But what is the precise reference of the αὐτῶν? It should stand for the στόμα and the μυκτῆρες. But in that case what is the meaning of τῆς ἀρχῆς αὐτῶν? Galen's commentary confines itself to expounding what he took to be the sense of the passage without discussing verbal details. Among modern commentators, M. apparently takes αὐτῶν to refer loosely to the two contrasted half-turns of the τροχός, and ἀρχή literally, as 'beginning', 'starting-point', since he renders 'la cause du commencement de ce mouvement périodique'. A.-H. perhaps intends the same by his words 'the cause which sets this principle in motion'. St. makes no comment. Ficinus had rendered by *causam quae principium his dat*, which seems to mean the same thing as M.'s version. I think M. is pretty certainly right in taking αὐτῶν (neuter) as standing vaguely for 'these things', viz. the double movement just described, and ἀρχή literally as 'starting-point', 'beginning', but it must be admitted that T. expresses himself obscurely, perhaps because his thought itself is not as clear as it should be. The general sense will be that the blood and viscera of an animal in life have a high normal temperature; they are a sort of 'well-spring of fire' (πηγὴ πυρός), or, as M.'s contemporaries would have said, contain a great deal of 'caloric'. This is what we had in mind when we spoke of the contents of the κύρτος as 'fire'. We have just seen that, in virtue of the principle of περίωσις, when air goes out of the body by either of the two ways of egress, there must be a compensating entrance of fresh air. We must now add that the temperature is alternately higher at one of the two entrances and again at the other. This is to explain why air alternately gets in by both entrances instead of simply coming in one way and going out by the other.

79 d 1–5. πᾶν ζῷον . . . ἀέρος. The πηγὴ πυρός in the living body is the vital heat, conceived of by Timaeus as an actual fire made of his minute pyramids. Galen censures this confusion of heat with a kind of body as unscientific; Plato should have spoken, if he meant to be accurate, as Hippocrates does of τὸ ἔμφυτον θερμόν, of which Galen says that εὔκρατόν ἐστι, κατὰ μὲν οὐσίαν ἐν αἵματι καὶ φλέγματι τὴν ὕπαρξιν ἔχον μάλιστα (and so is not one of the στοιχεῖα at all), κατὰ δὲ ποιότητα μεικτὸν ὂν εὐκράτως ἐκ θερμότητός τε καὶ ψυχρότητος (*de placitis Hippocr. et Plat.* viii, Müller 709 = Kühn 703). But Timaeus is no more unscientific in calling this θερμασία 'fire' than our own grandfathers were in believing in 'caloric'.

79 d 5–6. τὸ θερμὸν δὴ . . . ἰέναι. Thus the cause of respiration is simply the tendency, of which we have heard so much in earlier passages, of particles of each of the four primitive bodies, when left to themselves, to move in the direction towards the corresponding aggregate. This connects the physiology of T. with his more general physical theory, and affords another example of the care with which he maintains the correspondence between the μικρὸς κόσμος of man and the great κόσμος without. In what follows T. assumes as the starting-point of his explanation the condition of a body which is already full of air. He begins by explaining not how the air comes to be drawn into the body, but how it

comes to leave it. This justifies Aristotle's complaint that he inverts the actual order by making *ἐκπνοή* precede *εἰσπνοή*, but it is hardly consistent with the earlier and more general description of 78 d, where the entrance of air into the *ἐγκύρτια* precedes its exit (*τοτὲ μὲν εἰς τὰ ἐγκύρτια συρρεῖν μαλακῶς . . . τοτὲ δὲ ἀναρρεῖν μὲν τὰ ἐγκύρτια* κτλ.). This seems to show that the theory has not been thoroughly thought out, and is therefore probably not devised by Plato for his Pythagorean, since there would in that case be no reason why he should introduce the discrepancy, but really taken from the science of the fifth century B.C., which, like the science of the twentieth century A.D., was not always rigidly logical.

79 d 6–e 3. δυοῖν δὲ . . . ψύχεται. The two 'channels' are the channel through the *πόροι* and that of the respiratory passages. When *τὸ θερμόν*, seeking to unite itself with the great cosmic aggregate of fire, takes either direction out of the body (*ὁρμήσῃ*, e 1, intrans.), this leads by *περίωσις* to the entry of fresh air, apparently by the other channel (*θάτερα περιωθεῖ*). And the air which thus intrudes into the body is heated by its contact with the internal *πηγὴ πυρός*, while what leaves the body falls in temperature in consequence of its removal from this source of heat. So far, all is plain sailing, but the theory still does not correspond to fact. As it stands, it would require that air which has got in at one entrance should always go out at the other. For example, the escape of air from mouth and nostrils should cause a *περίωσις* which leads to the entrance of fresh air by the other route. But we all know that if e.g. we inflate our lungs by a deep breath, the air does not escape through the skin; we have to expel it at nose or mouth again. This is, no doubt, the point to the explanation of which T. is leading up in what he says about the rise and fall of temperature. The working out of the consequences of these thermal changes then follows in e 3–6.

79 e 3–6. μεταβαλλούσης δὲ . . . τὸ κατὰ θάτερα. The point to be cleared up, then, is this. We should naturally expect from the general account of *περίωσις* that air would get into the body sometimes by one channel, sometimes by the other, according to circumstances. But whichever way it came in, it would escape by the other. Thus the 'wheel' of which T. speaks would not always revolve in the same sense, but would make *complete* turns in both senses. The facts require that this shall not be so, but that air which comes in at the respiratory passages shall also go out by them, and that air which gets in through the skin shall also go out by transpiration through the skin. Thus the 'wheel' neither revolves always in one sense nor describes alternate complete circles in contrary senses; it makes, as Galen says, commenting on the *ἔνθα καὶ ἔνθα* of e 8, 'half-turns' in contrary senses, and the cause of this is that each of the two entrances is alternately of higher temperature than the other. The problem which creates the whole difficulty of the theory is that of the precise exegesis of the clause *μεταβαλλούσης . . . θερμοτέρων γιγνομένων*. Has T., granting his own initial postulates, accounted for the alleged fact that each 'exit' is alternately warmer than the other? And exactly how do the four stages of the process which is made up of two double half-turns succeed one another? There are two passages in Galen's com-

mentary which, taken together, seem to indicate the answer he supposed the correct one to the second question. The first (Dar. p. 30) occurs in his explanation of the words *πάλιν δὲ . . . μυκτήρων δίοδον* (79 a 5–c 7) and runs thus, *ὅταν μὲν διὰ τοῦ στόματος ἐκπνέωμεν, συμβαίνειν* (sc. *βούλεται*) *τὸν ἐκ τῶν κυρτίων* (but surely we should write *ἐγκυρτίων*), *ἀέρα φερόμενον ἔξω περιωθεῖν τὸν ἔξωθεν ἀέρα διὰ τοῦ δέρματος μόνου, τὸν δὲ φέρεσθαι πρὸς τὸ βάθος τοῦ σώματος ἀναπληροῦντα τὴν χώραν τοῦ κατὰ τὴν ἐκπνοὴν ἀέρος ἐκτὸς φερομένου· ὅταν δ' αὖ πάλιν ἐπὶ τὴν διὰ τοῦ δέρματος ἐκτὸς φορὰν ὁρμήσῃ τότε* (but l. *τε* as Dar. suggests) *ἡ θερμασία καὶ τὸ πνεῦμα, περιωθούμενον αὖθις τὸν ἔξωθεν ἀέρα φέρεσθαι διὰ τοῦ στόματος ἔσω τοῦ σώματος*, 'he means that when we exhale through the mouth, the air which is passing out of the pouches drives round the external air through the skin, and this is conveyed into the interior of the body and fills up the room of the air which is being conveyed outward by exhalation; again, in the other case, when the heat and breath take the path outward through the skin, the external air is driven round into the body by way of the mouth'. Thus Galen lays it down that the expulsion of air by either channel is immediately followed by entrance of air through the other, and there seems no other way of interpreting the general account of *περίωσις*. The only way in which this condition can be satisfied is clearly that the escape of air by one of the two channels should be followed by its entrance at the other, this by escape of the second supply of air at the same entrance where it came in, and this finally by the entrance of a third supply of air at the entrance where the first supply went out. If we call entrance at the two openings a_1, a_2 respectively, and escape b_1, b_2, the parts of the process must have the cyclical order $b_1\, a_2\, b_2\, a_1$. That is, air must always get out of the body by the same path by which it came in. Thus the escape of breath from mouth and nostrils will be followed by the entrance and exit of air through the *πόροι* of the skin, this by entrance of air at mouth and nostrils, and then the cycle will begin again with expulsion of air from mouth and nostrils. When once the process has been started, there will be a regular alternation of a complete inspiration and expiration by one channel with a complete inspiration and expiration by the other. It still remains to be explained why the two exits should alternate in temperature and precisely how this alternation brings about the rhythm in question. Galen's comment (Dar. p. 32) is as follows: *σαφῶς ἐδήλωσε νῦν τὴν ἐν τῷ βάθει χώραν, ἐν ᾗ φησιν εἶναι τὸν οἷον κύρτον, ἣν ὠνόμασε πηγήν τινα πυρός· ταύτην οὖν τὴν θερμασίαν ἀναθεῖν βούλεται πρὸς τὸ ξυγγενές· ἐὰν μὲν οὖν φθάσῃ κατὰ τὴν διὰ τοῦ στόματος ἔξοδον ἡ ὁρμὴ τῆς* ⟨*θερμασίας τῆς*⟩ *φλεβός* (the Latin version has simply *caloris impetus*, which perhaps suggests that the awkward *φλεβός* should be deleted and ⟨*τῆς θερμασίας*⟩ read), *τὸ θερμὸν ἐμπῖπτον τοῖς ἐντὸς ἀεροειδέσι κοιλότησιν ἅμα μὲν τέμνειν τε καὶ καταθραύειν τὰ κατ' αὐτάς, ἅμα δὲ καὶ συνεπισπᾶσθαι τὸν ἔξωθεν ἀέρα, καὶ οὕτως συμβαίνειν τὸ μὲν περιωσθὲν εἰς τὸ θερμὸν ἐμπῖπτον, ὃ δὴ πῦρ ὠνόμασε, θερμαίνεσθαι, τὸ δ' ἐξιὸν ψύχεσθαι, ἕπεσθαι δὲ πάλιν ἐν* (? *dele ἐν*) *τῷδε, τὸ μὲν θερμανθὲν ἀναθεῖν πρὸς τὸ ξυγγενὲς διὰ τῆς ἐκτὸς ἐπιφανείας, ἀκολουθεῖν δ' αὐτῷ τὸν κατὰ τὰς ἔνδον κοιλότητας ἀέρα, τούτῳ δὲ πάλιν ἕπεσθαι τὸν ἄχρι τοῦ στόματος . . . , καὶ κατὰ τοῦτο πάλιν ὠθούμενον τὸν*

πλησίον ἀέρα καὶ αὐτὸν αὖθις ὠθεῖν τὸν συνεχῆ, κἀκεῖνον ὁμοίως τὸν μεθ' ἑαυτοῦ, ἄχρις ἂν ἐν τῇ περιώσει ταύτῃ πάλιν εἰς τὸ κενούμενον τοῦ σώματος ὁ ἀναπληρώσων ἀὴρ αὐτὸ παραγένηται. 'An unmistakable reference to the interior (of the body), in which he says the "fish-trap" is, and which he calls a "fountain of fire". He means, then, that this heat mounts upwards towards that which is akin to it. If, then, the endeavour of the heat is in the first instance towards the exit at the mouth, the heat invades the cavities of air within; it cuts up and minces their contents (a reference to the account of digestion), and at the same time draws after itself air from outside the body; so it comes about that what has been pushed round falls upon the heat which *he* calls fire, and is heated, but what is going out is cooled. A further consequence of this is that what has been heated mounts upwards in the direction of what is akin to it *through the outer surface* (i. e. goes out again by the πόροι of the skin), and is followed by the air in the internal cavities. This is followed by that which extends as far as the mouth, . . . and thus once more the neighbouring air (i. e. that in the neighbourhood of the passages in the skin from which air is now issuing) receives a thrust, and in turn thrusts that which is contiguous to it, and so on until by this circular impulsion the part of the body which is being left empty is again reached by the air which is to fill it (i. e. until air is forced in again at mouth and nostrils).' Galen thus gives us just the four stages we have already constituted, (*a*) escape of air by the respiratory passages, (*b*) a περίωσις which leads to the entrance of fresh air by the πόροι of the skin, (*c*) expulsion of this through the πόροι at which it has just entered, (*d*) a second περίωσις leading to the entrance of air at the respiratory passages. (See on all this Daremberg, n. 78, p. 51, and n. 75, p. 50.) The result is that the 'wheel' describes not one complete circle in the same sense, but two semicircles in contrary senses, ὡς αὐτὸς εἶπεν, ἔνθα καὶ ἔνθα, . . . οὐ κατὰ κύκλον ἀεὶ τὸν αὐτόν, ἀλλ' ὡς ἄν τις εἴποι, κατὰ δύο ἡμικύκλια ἐναντίως ἀλλήλοις κινούμενα. Unfortunately he leaves the alternate rise and fall of temperature at the two exits entirely unexplained. Martin deals with the matter in his n. 169 (*Études* vol. ii, pp. 334–9), but does little more than repeat what we have already learned from Galen. The general drift appears to be this. The blood of an animal has a high constant temperature, it is a 'natural fountain of fire'. On the general principle of περίωσις, when any of this 'fire', along with the air which it has heated, escapes at either exit, there must be a compensating inflow of air at the other. But the temperature of the inflowing air naturally rises as it approaches the 'fountain of fire', and that of the outgoing air sinks. Consequently the exit by which the air is escaping is cooled, therefore the air and fire which is moving in πρὸς τὸ ξυγγενές takes its way in and out again by the other, which is for the time the warmer, passage. This is why expulsion of air is followed by inspiration of it at the same entrance.

The theory, as it seems to me (apart from its mistake about the way in which a 'draught' is created), will not really hang together. There is a discrepancy between the principles of περίωσις and of movement πρὸς τὸ ξυγγενές, and both are being used at once. From the principle of περίωσις it ought to follow that air which enters the body by one channel

should always get out by the other. It should drive out the air already present at that other channel and then follow it. The 'wheel' would thus always make complete turns. As this is manifestly not the fact, Timaeus introduces the other principle of movement *πρὸς τὸ ξυγγενές*. When air leaves the body by mouth or nose, a *περίωσις* is set up which forces in more air through the skin. But *this* air does not get out, as on the principle of *περίωσις* it should, by nose or mouth. That exit has been cooled by the escape of the former air, and so now, the air which has been heated in the body, and therefore contains fire, goes out by the warmer path, that at which it came in. This, the most peculiar feature of the whole theory, seems to me a piece of incoherence. If the escape of air, slightly cooled by leaving the very 'central fire' of the body, cools the passage at which it goes out, the entrance of air by *περίωσις* from outside ought also to cool the passage at which it comes in. Hence I cannot see that T. has given any good reason for the alternations of temperature which are indispensable to make his account square with the notorious fact that we cannot get rid of air taken in at the respiratory passages by transpiration through the skin, or exhale air at these passages without having to inhale by the same passages. The brevity and vagueness of the statement on this all-important point may suggest that Plato was alive to the badness of the explanation. The incoherence of the theory is probably the reason why it was in fact dropped by the Academy. Galen tells us expressly that the Academy, unlike Plato, made the 'wheel' describe not semicircles in contrary senses, but a complete circle in one sense, *καὶ κατὰ τοῦτο διήνεγκεν ἡ τοῦ Πλάτωνος δόξα τῆς ἐξ Ἀκαδημίας, οὐχ ὡς Ἐρασίστρατος ἔγραψεν· ἐκείνη μὲν γὰρ κατὰ κύκλον ἀκριβῆ διὰ παντὸς περιφέρεσθαι τὸν ἀέρα ἐπὶ τὰ αὐτὰ καὶ ὡσαύτως βούλεται, αὕτη δ' οὐ κατὰ κύκλον ἀεὶ τὸν αὐτόν, ἀλλ'... κατὰ δύο ἡμικύκλια ἐναντίως ἀλλήλοις κινούμενα* (Dar. p. 34). This means that the accepted view in the Academy was that air always comes into the body at one entrance and leaves it at the other. (Since no one can deny that we breathe both in and out by the respiratory passages, presumably the theory is that though each 'turn' of the wheel is a complete circle, alternate turns are in opposite senses.) This testimony seems unexceptional since we know that Galen used the earlier full and learned writings of Posidonius, and, since his language implies that Erasistratus had already mentioned a divergence of the Academy from the 'view of Plato', though Galen says he had not described the difference exactly, the 'non-Platonic' theory of the Academy must be presumed to be as old as the beginning of the third century B.C.; i.e. it most likely goes back to the time of Xenocrates (d. 314), and was therefore possibly the view of the Academy from the beginning. This again suggests that Plato's associates may very well have known from the first that the peculiar theory of Timaeus was not a *δόξα Πλάτωνος*. The same thing is indicated by the passage about respiration in the *Timaeus Locrus* (101 d—102 a), where there is no reference to the 'half-turns' or the alternations of temperature mentioned by T. The theory there is simply that all the appearances are due to *περίωσις* alone. The air first enters the body through the skin and is driven out at mouth and nose, then there is a 'turn of the tide' (*εὔριπος*), and it enters again through mouth and

nose to go out at the skin. This is precisely what Galen calls the 'Academic' view. The rhythm assumed by T. to be $b_1 a_2 b_2 a_1$ has now become $b_1 a_1 b_2 a_2$.

Aristotle's criticisms on this part of the dialogue are contained in the small essay among the *Parva Naturalia* on *Youth and Age, Life and Death, and Respiration.* The reason for discussing respiration in such a connexion is that the living or not living of some animals (Ar. held that not all animals breathe) is dependent on their ability or inability to keep up respiration. Ar. begins the discussion with a remark aimed at the extension of the name ζῷον to all living things. Timaeus had justified this extension at 77 b 1–3, and it is characteristic of the Empedoclean biology that it recognizes no distinction in principle between φυτά and ζῷα. Aristotle insists that there is a fundamental distinction; plants 'are alive but have not sensation, and it is by the criterion of sensation that we distinguish an animal from what is not an animal' (op. cit. 467^b 23). As regards respiration in particular, he complains that it has not been adequately treated before his own time. Some of those who have dealt with it have not explained what purpose it subserves, and the explanations given by others are not satisfactory. Anaxagoras and Diogenes of Apollonia hold that all ζῷα breathe, and they explain how fishes and shell-fish do so under water, the former saying (470^b 33) that when fishes emit water at their gills they draw in air through their mouths, 'since there is no void', the latter that they draw in the air from the water round them 'by the void formed in their mouths', when the water is expelled at the gills (471^a 2–5). But they do not and cannot explain how such creatures *exhale* air. They would have to say that they exhale it through their mouths in the very act of inhaling it, and this is impossible, as the two antithetic processes would inhibit one another (471^a 10 ff.). Again, 'when they emit the *water*, they will also be exhaling air either at the mouth or at the gills. But it is at this very moment that they are supposed to be inhaling, and exhalation and inhalation cannot be contemporaneous' (471^a 14–17). Ar. then raises anatomical difficulties into which we need not enter and adds that if Anaxagoras and Diogenes are right about fishes, men also ought to be able to breathe under water by inhaling air from the surrounding water (471^b 6). Ar. thinks that the inability of fishes to live out of water proves that they do not breathe at all. Diogenes had attempted to account for the fact by saying that a fish out of water chokes itself by breathing *too much* air (as Hobbes long afterwards said the same thing about mice which die in the receiver of an air-pump) but this, Ar. observes, is silly, for if you could choke yourself in this way, the thing ought sometimes to happen to land-animals. Ar. next considers Democritus, whose theory was that the small atoms composing the ψυχή are inhaled from the air, so that breathing is necessary to keep the ψυχή in being and the animal alive (op. cit. 471^b 30 ff.). This is an instance of a theory which does assign a real use to breathing, but a wrong use. The view of Democritus, then, is that the atoms of ψυχή and those of 'the hot' are identical; they are minute spherical particles. Those of them already in the body are constantly being pushed out, and breathing replenishes the supply. Aristotle naturally does not take such

a theory very seriously, and specially notes that D. had given no account of the mechanism of the process.

He now comes to the account of Timaeus (op. cit. 472b 6—473a 14). He first remarks that 'the περίωσις of the *Timaeus* (ἡ ἐν τῷ Τιμαίῳ γεγραμμένη περίωσις, he does not call it a theory of Plato), as described there only applies to the case of land-animals. It ought to be stated whether other creatures breathe or not. If they do not, it should be explained why *their* vital heat does not require to be kept at the right temperature by breathing; if they do, the mechanism in their case must be different from that assumed by T. and should have been described. This is hardly a fair criticism, since T.'s assumption that all other animals have been 'evolved by degeneration' from the human type makes it reasonable for him, in a cosmology which is announced as ending with the emergence of man, to describe the anatomy and physiology of the human body without going into details about subsequent divergence from the type.

The next criticism is much more effective. It is a false assumption that the whole process starts, as T. makes it do, with ἐκπνοή, the expulsion of air *via* mouth and nostrils. There must be inhalation (εἰσπνοή) before there can be any exhalation. The theory leaves it quite unexplained why life ceases if we cannot keep up the process of respiration. The account of the succession of the stages is fanciful (πλασματώδης ὁ τρόπος τῆς αἰτίας). (This alludes, as the αἰτίας shows, to 79 c 7 ff. Aristotle enumerates the four stages in T.'s order, expulsion of air by the special respiratory passages, entrance of the fresh air at the πόροι of the skin in virtue of ἀντιπερίστασις, expulsion of this air by the way it came in, entrance of air by ἀντιπερίστασις at the mouth and nostrils.) It is odd that if heat really goes in and out through the trunk as well as at mouth and nostrils, we should be sensible of the second process but not of the first. And it is equally strange to think that breathing is entry of heat into the body at all, for we all know that air inhaled is cool, but air exhaled warm. In fact, if we try to inhale hot air, we soon gasp for breath (ἀσθμαίνοντες ἀναπνέουσιν).

Next, as to the alleged purpose of respiration, the maintenance of an equable internal heat to concoct our food. T. says in effect that the air we breathe serves as fuel to an internal fire, and that exhalation takes place when the fire has been duly made up (ἀναπνέοντος μὲν ὥσπερ ἐπὶ πῦρ ὑπέκκαυμα ὑποβάλλεσθαι, τραφέντος δὲ τοῦ πυρὸς γίνεσθαι τὴν ἐκπνοήν, 473a 5). Again, we may ask whether or not this happens in *all* animals, since all animals have vital heat. Besides, it is an arbitrary fancy (πλασματῶδες) to say that the heat is produced by breath; we can see for ourselves that it is the food (τροφή) itself which supplies this heat (μᾶλλον γὰρ ἐκ τῆς τροφῆς τοῦτο γινόμενον ὁρῶμεν, ib. 11). He adds that on the theory nutriment enters and a waste product (exhaled air) is excreted by the same channel, but such an arrangement would be unique in nature.

Next Ar. deals with Empedocles, whose theory, as we have seen, is really the foundation of T.'s doctrine, and it is this discussion to which we owe the preservation of E.'s lines about the water-clock. Ar. objects that, no doubt, E.'s doctrine, if we accept it, will explain the entrance of air into and its expulsion from the nostrils. But it is the windpipe

which is the fundamental thing. An animal need not suffer any harm from the stoppage of its nostrils; if its windpipe is stopped it dies. But if you take the part played by the windpipe into account, the simile of the water-clock becomes inappropriate. In inhaling the air down the windpipe we lift up the chest like the bellows of a smithy; when we exhale, we let it sink together again, just as the bellows collapse when the air is blown out of them (*ἄραντες μὲν γὰρ τὸν τόπον, καθάπερ τὰς φύσας ἐν τοῖς χαλκείοις, ἀναπνέουσιν . . . συνιζάνοντες δὲ καὶ καταπλήττοντες, ὥσπερ ἐκεῖ τὰς φύσας, ἐκπνέουσιν*, 474ª 12). (This is meant to contradict E.'s view that air only gets into the body by the withdrawal of the blood inwards towards the heart, and is driven out as blood is sent pulsing back again from the heart.)

Aristotle's own theory is that digestion of food, which is necessary to life, depends on vital heat; so far he agrees with the theory of digestion which Timaeus has still to expound. But refrigeration is needed to keep up vital heat, for if a fire is kept very hot and not supplied with fresh unheated material, it goes out of itself from sheer exhaustion (*μάρανσις*). (*καὶ γὰρ ἂν ὑπερβάλλῃ τὸ πέριξ θερμόν, καὶ τροφὴν ἐὰν μὴ λαμβάνῃ, φθείρεται τὸ πυρούμενον, οὐ ψυχόμενον ἀλλὰ μαραινόμενον. ὥστ' ἀνάγκη γίνεσθαι κατάψυξιν, εἰ μέλλει τεύξεσθαι σωτηρίας*, 474ᵇ 20–4.) The fact after which Ar. is feeling dimly is that oxidization is necessary to combustion. What really happens to the fires of which he is speaking is that they go out for lack of oxygen. This is what he means by the rather crude statement that refrigeration is needed to keep the fire going. He is thinking of the familiar fact that in an overheated room to which no cool air is admitted the fire quickly dies down.

Now animals which breathe are all animals with a high internal temperature, and therefore stand specially in need of this constant refrigeration. To put it in a homely way, the fire in them needs frequent poking. This is what the lungs and the whole respiratory apparatus are for; *τοῖς ἐναίμοις καὶ τοῖς ἔχουσι καρδίαν, ὅσα μὲν ἔχει πλεύμονα, πάντα δέχεται τὸν ἀέρα καὶ τὴν κατάψυξιν ποιεῖται διὰ τοῦ ἀναπνεῖν καὶ ἐκπνεῖν*, 475ᵇ 16. Fishes do not need to breathe, he says, because they take in water through their gills, and the water serves the purpose of refrigeration. I think it must be said that Aristotle is justified in most of his criticisms of Empedocles and Timaeus. He is right in saying that for a real mechanical analogy we must look not to the clepsydra but to the dilatation and contraction of a pair of bellows at work. He is right again in insisting that any theory ought to make inhalation a necessary antecedent to exhalation. He urges the point only against Timaeus, but it holds good equally against Empedocles. The probable reason why he does not mark the point against E. is a singular one. E. says in the verses in question (Fr. 100, l. 3) that all things have tubes in their bodies, and that at the mouths of these tubes the surface of their skins is penetrated by pores, *καί σφιν ἐπὶ στομίοις πυκιναῖς τέτρηνται ἄλοξιν | ῥινῶν ἔσχατα τέρθρα.* Aristotle oddly mistook the word *ῥινῶν* (gen. pl. of *ῥινός*) in this passage for the gen. pl. of *ῥίς*. This is why he goes on to say that E. argues as though the *nostrils* were the whole of the respiratory apparatus and forgets the windpipe; it is also why he overlooks the point that E. makes us

breathe out of our mouths and nostrils before we have ever breathed in by them. (T.'s view of the *purpose* of respiration, that it is a way of bringing fresh supplies of 'fire' or 'caloric' into the system, is probably not from Empedocles, since Ar. expressly observes that E. had said nothing about the 'end' subserved by breathing; op. cit. 473ª 15 λέγει δὲ περὶ ἀναπνοῆς καὶ Ἐμπεδοκλῆς, οὐ μέντοι τίνος γ' ἕνεκα.) Finally, Ar. is getting very near the mark in his own view that the way in which respiration subserves digestion is not by adding to the 'internal fire' but by κατάψυξις, 'letting in the draught' on it. (A.-H.'s reference to Aristotle's treatment of the subject is far too grudging.) Galen has some useful criticisms on the whole theory in the eighth book of his work *de placitis Hippocratis et Platonis* viii. 714 = Kühn 708. What T. explains is not so much ἀναπνοή, respiration, as διαπνοή, perspiration, transpiration, and even this is not correctly explained, ἀναιρεῖ γὰρ ὁλκήν (attraction), ᾗ πρὸς πολλὰ τῶν φυσικῶν ἔργων ὁ Ἱπποκράτης χρῆται. Hence Plato has to fall back on the strange theory of περίωσις to explain what are really effects of ὁλκή. The part played by the thoracic muscles is also wholly overlooked, with the result that ἀναπνοή is not properly discriminated from διαπνοή, a process by which Galen himself supposed air to be brought into the arteries so that the blood is duly aerated (ib. 715). The next criticism, that Plato forgets that we have voluntary control over the thoracic muscles will be noted more fully on 80 a 1. If T.'s theory were sound, a systole of the arteries should be immediately followed by an inhalation, and an exhalation by a diastole of the arteries, viii. 720 = Kühn 712. (This follows from T.'s account of the cyclical order of the four stages.) But this is not found to be the case. Again (ib.) the whole account of the περίωσις is ἄτοπος. There is no real reason why exhalation should be followed by entrance of air through the skin, since ἑπομένης τῆς ἐκπνοῆς τῇ συστολῇ τῶν ἀναπνευστικῶν, ἐκείνῃ τῇ συστολῇ ἀκολουθῶν ὁ περικεχυμένος ἡμῖν ἀὴρ χώραν παρέχει τῷ ἐκπνεομένῳ. That is, as the thoracic muscles relax and the chest falls together again, there will be an εἰσπνοή at mouth and nostrils, and thus the room just occupied by the 'air around us' will be left free for the air which is being expelled; the περίωσις of T. is therefore superfluous, and with it the interpolation of entrance and exit of air by way of the skin between each true exhalation and the following inhalation.

79 e 6. πρὸς τὴν αὐτοῦ φύσιν φερόμενον. That is, when the 'other exit' becomes the warmer, the escaping 'fire' in the body, which is on the way to join the 'cognate' fire outside, takes that path, because, in virtue of the movement of 'like to like' which accounts for its escaping at all, it must always go out by the exit where there is most fire at the moment, i. e. at the warmer exit. 'But when the temperature changes, and the parts about the other exit become the warmer, the heated matter, being borne towards its like, sets in turn (πάλιν) in that direction, and causes a περίωσις at the opposite exit.' M. seems by his rendering to take the words πρὸς . . . φερόμενον as if they were a mere restatement of the alleged fact that τὸ θερμότερον seeks to rejoin the great cosmic aggregate of fire, but this makes the clause otiose. The thing to be explained is why, in moving towards this aggregate the θερμότερον in the κύρτος takes two routes in alternation. A.-H. renders rightly. The μᾶλλον

of e 5 must be taken with *θερμότερον*, not with *ἐκείνῃ ῥεπόν*. For examples of this pleonastic combination of *μᾶλλον* with a comparative adjective see Madvig *Greek Syntax* (E. Tr.), § 93 c, Matthiae *Greek Grammar* (E. Tr.) §. 458, Riddell *Digest of Idioms* § 166, and for a parallel from our own dialogue cf. 87 c 3 *δικαιότερον γὰρ τῶν ἀγαθῶν πέρι μᾶλλον ἢ τῶν κακῶν ἴσχειν λόγον*. As the authorities just cited show, the construction is relatively common in Plato.

79 e 10—80 c 8. καὶ δὴ καὶ τὰ τῶν περὶ τὰς ἰατρικὰς . . . φανήσεται. The short section which follows has nothing to do with *ἀναπνοή*, but is inserted between the account of its mechanism which has just been given and the account of its function which is to follow merely for the sake of illustrating the nature and importance of *περίωσις* or *ἀντιπερίστασις*, the one kind of movement possible in a perfectly homogeneous *plenum*, by a variety of fresh examples. The object is to show that *antiperistasis* is one of the most universal characteristics of nature, that it is, in fact, a *vera causa*. The fragment of Galen's commentary unfortunately breaks off here; in the absence of its continuation, the fullest explanation of the passage, on which those of modern commentators are founded, is that given by Plutarch in *Quaestiones Platonicae* vii. T. for the most part contents himself with mentioning the 'appearances' and leaves it to his hearers to see for themselves how these appearances are accounted for by the 'circular motion'. The general effect of the theory is that all motion which we should explain by 'attraction' or by diminution of 'atmospheric pressure' is explained as a case of impulsion *a tergo*. To put it very simply, the theory is that there are no 'pulls' in nature, there are only 'pushes'. The fascination the conception seems always to have retained, as is shown by some of the attempts of more recent times to get behind the Newtonian conception of gravitational 'attraction', is probably due to the curious prejudice that, while it is self-evident how one particle can push another, it is not equally self-evident how one can pull another.[1] Hence the attempts to account for gravitation as due to an incessant bombardment of the exposed faces of the gravitating bodies. The combination of the prejudice in favour of a push against pull with the other prejudice against vacuum must lead, if thought out, to the view that *περίωσις* is universal in nature.

The examples given by Timaeus are (*a*) the use of 'cupping' in medicine, (*b*) the deglutition of food, (*c*) the motion of projectiles and bodies sliding on a plane surface, (*d*) the transmission of sound, (*e*) the flowing of water downhill, (*f*) the fall of 'thunderbolts', (*g*) the 'attraction', as we now say, of amber and of the magnet. In a modern work all this material would be put into a foot-note to the effect that 'the general principles already laid down will account for the following facts, but the detailed application in each case must be left to the reader'. Or, at most, there would be an excursus at the end of the volume on 'further illustrations of the principles of *περίωσις*'. But in a Greek book of the fourth century foot-notes were impossible for the same reason which is the

[1] I am not referring here to the attempt to found physics on a *geometry* of the infinitely near. That, as far as I can understand, has nothing to do with either of the prejudices mentioned but arises from the strictly geometrical work of Riemann.

true explanation of the looseness with which classical writers commonly quote their precursors. The book was written, in narrow columns, on one or more continuous rolls without pagination. This made the appending of notes out of the question; what in substance is an illustrative note has somehow to be worked into the main substance of the writer's exposition. Similarly the verification of quotations from lengthy works was almost impossible until the folded sheet took the place of the roll.

79 e 10. τὰς ἰατρικὰς σικύας. So called because of their gourd-like shape; cf. the Latin *cucurbita*. There are fairly numerous references to their use in the Hippocratic *corpus*. The cup is always heated before application, the real reason being that the heating rarefies the air in the cup and so creates a difference in the pressure on the flesh immediately under the cup and the neighbouring parts. Plutarch explains Timaeus to mean that the heated air evaporates through the πόροι in the metal of the cup. It then repels the neighbouring air and sets up a 'pulsion' which is in the end transmitted to the flesh under the cup. This is consequently thrust up, swells, and 'expresses its humours' (συνεκθλίβει τὸ ὑγρόν) into the cup (Plut. op. cit. 1004 f–1005 a). This is a good illustration of Galen's censure that Plato insists on completely ignoring ὁλκή as a mechanical principle. A precise parallel is afforded by Hobbes's theory that the effect of working an air-pump is not to rarefy the air in the receiver but to force in fresh air which takes the place of that which escapes through the body of the apparatus, and so to make a violent hurricane on a small scale. The mice, &c., in the receiver thus do not die for want of air, but are suffocated! (*Seven Philosophical Problems* 3, Molesworth, vii. 20–2).

80 a 1. καὶ τὰ τῆς καταπόσεως. The usual periphrasis for ἡ κατάποσις. The facts of deglutition. Plutarch explains 'the hollows of the mouth and gullet are always full of air. So when the food has been pressed down by the tongue (ὅταν ἐμπιεσθῇ τὸ σιτίον ὑπὸ τῆς γλώττης), and the tonsils simultaneously stretched taut (ἅμα καὶ τῶν παρισθμίων ἐνταθέντων), the air is squeezed out in the direction of the palate, is contiguous with what is descending, and helps to push down the food (ἐκθλιβόμενος ὁ ἀὴρ πρὸς τὸν οὐρανὸν ἔχεται τοῦ ὑποχωροῦντος καὶ συνεπωθεῖ τὸ σιτίον' op. cit. 1005 a). That is, air in the 'cavities of the mouth and gullet', which was itself at first being pushed down by the food escapes upwards, and then, by exerting a downward pressure on everything underneath it, helps to push down the food towards the region from which it has itself escaped. The really curious thing is that T. makes no use of the *muscles* in this explanation any more than he had done of the thoracic muscles in his account of breathing. Galen rightly notes this curious point in his complaint of the neglect of ὁλκή in the 'Platonic' physics. As he says (*de placitis Hippocr. et Plat.* viii. 715 = Kühn 708) the distended thorax actually draws in the air, ἕλκει διὰ τῆς τραχείας ἀρτηρίας ἀναγκαίως εἰς τὸ στόμα τὸν ἔξωθεν ἀέρα. A consequence of this neglect of the part played by the muscles is that 'Plato' mistakenly makes inhalation a mere *passive* condition, a πάθος instead of an ἐνέργεια, and quite overlooks the point that we have voluntary control of both inhalation and exhalation (op. cit. viii.

719 = Kühn 712 ἐν οὐδετέρᾳ δὲ αὐτῶν ὁ Πλάτων προσχρῆται τῇ προαιρέσει, καίτοι φανερῶς ἐν ἡμῖν ὄντος καὶ τὸ θᾶττον καὶ βραδύτερον ἔλαττόν τε καὶ πλέον καὶ πυκνότερον εἰσπνεῦσαί τε καὶ ἐκπνεῦσαι).

80 a 1–2. τά τε τῶν ῥιπτουμένων . . . διωκτέον. We come now to the facts about projectiles and bodies made to slide or roll along the ground. The theory will be sufficiently made clear by considering the first case. The idea is that the projectile divides the air, which at once closes up again by flowing round to the back of it so as to prevent the formation of a vacuum. Getting behind the missile in this way, the air then pushes it on and, according to Plutarch, actually accelerates it. Plut. op. cit. 1005 a τὰ δὲ ῥιπτούμενα βάρη τὸν ἀέρα σχίζει μετὰ πληγῆς ἐμπεσόντα καὶ διίστησιν· ὁ δὲ περιρρέων ὀπίσω, τῷ φύσιν ἔχειν ἀεὶ τὴν ἐρημουμένην χώραν διώκειν καὶ ἀναπληροῦν, συνέπεται τῷ ἀφιεμένῳ τὴν κίνησιν συνεπιταχύνων. Thus the missile is supposed to be kept from falling to the ground and actually speeded up as it flies by the very air which had received its first impulse to motion from the missile itself. Of course the analysis of the velocity of the projectile is widely inaccurate. Its initial velocity in the direction in which it is impelled remains constant, its gravitational *acceleration* is constant also. The *velocity* due to this acceleration increases proportionately to the time of flight. Timaeus, it may be noted, says nothing about any increase of velocity; Plutarch is presumably following some expositor who wished to get in the fact that the velocity directed towards the earth's centre of gravity does increase, but was not aware that velocity is a *directed* quantity. There is no increase in the velocity in the direction of the original impulse.

The fall of 'thunderbolts' (τὰ τῶν κεραυνῶν πτώματα) mentioned later on at 80 c 1 is only a special case of ῥιπτούμενα, 'missiles'. Plutarch (op. cit. 1005 b) explains that the fiery mass (τὸ πυρῶδες) of the supposed 'bolt' (really, no doubt, a meteoric stone) is hurled into the air (ἐκπηδᾷ ὑπὸ πληγῆς ἐν τῷ νέφει γενομένης) by a blow or clap in the thunder-cloud. The air makes way for it and then joins up behind it by περίωσις, as in the last case. The reason why it is thought necessary to account for the fact by a 'push' of the air and not as a mere 'fall' is that the κεραυνός is supposed to be, or to contain, 'fire', and therefore it ought, on T.'s principles, to move towards its own 'region', if there were no special impulse to push it towards the region of earth. So Plutarch (loc. cit.) says that the air ἄνωθεν ἐξωθεῖ κάτω παρὰ φύσιν ἀποβιαζόμενος τὸν κεραυνόν. Hobbes's account of the fall of heavy bodies, published in 1662, only twenty-five years before the appearance of Newton's *Principia*, is in all essentials no improvement on Timaeus. A stone falls with increasing velocity because it is pushed down by the air above it! *Philosophical Problems* 1 (Molesworth, vii. 9), 'as it descends and is already in motion, it receiveth a new impression from the same cause, which is the air, whereof as part mounteth (H. means that the stone in its ascent had been pushing air before it), part must also descend, supposing, as we have done, the plenitude (M. by error has *plentitude*) of the world'.

This method of explaining the motion of a projectile—i. e. answering the question why, when it has left the hand or bow or catapult, it does not simply drop vertically to the ground—by the principle of περίωσις or

ἀντιπερίστασις is commented on by Aristotle at the end of the *Physics* (Θ. 266^{b} 25). The puzzle which the ancients felt about the matter can perhaps be best brought home to us by considering a penetrating remark of Galileo. Galileo remarks, in the *Discorsi sopra le nuove scienze*, that you cannot compare the magnitude of a force which produces its effect by uniformly accelerating motion with that of an 'impact' which communicates an instantaneous velocity. Take e.g. the case of the effect of 'gravity' on a bullet fired from a rifle. The velocity the bullet has in the direction in which it issues from the gun is whole and complete at the very first instant. But *some* lapse of time, however short, is required to produce any velocity, however small, by constant acceleration. Hence Galileo said that any 'impact' is of infinite magnitude by comparison with any acceleration. This is the true reason why there is not really the paradox the ancients thought there was in the flight of a projectile. (Cf. the remark of Mach *Science of Mechanics* [E. Tr. ed. 1] 311–13, that this statement 'which is sometimes attributed to intellectual obscurity on Galileo's part, is, on the contrary, a brilliant proof of his intellectual acumen'.)

Aristotle puts the difficulty thus, 'if everything which moves is set moving by something else (except in the case of things which move themselves), how is it that some things move continuously without retaining contact with that which set them moving, i.e. projectiles?' (πῶς κινεῖται ἔνια συνεχῶς μὴ ἁπτομένου τοῦ κινήσαντος; οἷον τὰ ῥιπτούμενα, *Phys.* Θ. 266^{b} 29). If you say that the man who started the projectile on its course at the same time set moving something else as well, viz., the air, and that this something else thus both moves itself and sustains the motion of the projectile (εἰ δ' ἅμα κινεῖ καὶ ἄλλο τι ὁ κινήσας, οἷον τὸν ἀέρα—a pretty clear allusion to T.'s views—ὃς κινούμενος κινεῖ), it is just as impossible for this to move when the source of the impulse is not in contact with it and setting it in motion (ὁμοίως ἀδύνατον τοῦ πρώτου μὴ ἁπτομένου μηδὲ κινοῦντος κινεῖσθαι, ib. 32). That is, the continued movement of the air supposed to push the projectile on, calls for explanation just as much as the continued motion of the projectile itself. All the motions must be performed together and finished together as soon as the source of the first impulse ceases to act (ἀλλ' ἅμα πάντα καὶ κινεῖσθαι καὶ πεπαῦσθαι [sc. ἀνάγκη], ὅταν τὸ πρῶτον κινοῦν παύσηται, ib. 33—267^{a} 1). If the action is to be like that of the loadstone (ἡ λίθος, another allusion to T.'s examples), i.e. if *B* which was originally set moving by *A*, in its turn imparts motion to *A*, then, of course, we must hold that the original source of motion makes something else able to *impart* motion, whether this something else be supposed to be air in a certain condition, or water, or whatever it may be. εἰ ποιεῖ ὥσπερ ἡ λίθος, οἷον κινεῖ ὃ ἐκίνησεν (the ὅ here is of course accusative after ἐκίνησεν), ἀνάγκη δὴ τοῦτο μὲν λέγειν, ὅτι τὸ πρῶτον κινῆσαν ποιεῖ οἷόν τε κινεῖν, ἢ τὸν ἀέρα τοιοῦτον ἢ τὸ ὕδωρ ἤ τι ἄλλο ὃ πέφυκε κινεῖν καὶ κινεῖσθαι (267^{a} 1–5). 'But', he adds, 'it (sc. the thing which is made able both to move and to impart motion by the original agent) does not at one and the same moment cease both to move and to impart motion (οὐχ ἅμα παύεται κινοῦν καὶ κινούμενον, 267^{a} 5). It ceases to move as soon as the mover ceases to move it, but it still continues to

impart motion', (ἀλλὰ κινούμενον μὲν ἅμα (sc. παύεται), ὅταν ὁ κινῶν παύσηται κινῶν, κινοῦν δὲ ἔτι ἐστίν, ib. 5–7). The point of this criticism is that περίωσις does not fully account for the flight of the projectile. It is not enough to say that when the projectile is started it makes the air in front of it move. You must add that it also makes this body of air in its turn a cause of motion to another contiguous body of air, and so on. If you attend to this distinction, Ar. holds you escape the apparent paradox. A thing to which motion is imparted ceases to move when that which pushed it pushes it no longer, but it still retains the power to pass on the push to something adjacent. (It is hard to reconcile this assumption that a corporeal thing can be an 'unmoved mover' with the principles of Aristotle's philosophy. The ancient commentators tried to do so, but Simplicius is dissatisfied, and with good reason.) The next question raised seems to hit a real blot in T.'s theory. Why does not the projectile, once started on its path, go on for ever? Why should not περίωσις keep it going indefinitely? (Hobbes, whose theory of the *descensus gravium*, as we have seen, amounts to a doctrine of περίωσις, does actually, at *de Corpore* 30. 4 = *of Body* 30. 4, Molesworth, i. 513, raise the question whether a stone thrown upwards at one of the poles would ever come down again, and replies that we cannot say without making trial, which is hard to make 'because the places near the poles are inaccessible'.) Aristotle answers that the projectile must fall in the end, because the 'power of imparting motion' (ἡ δύναμις τοῦ κινεῖν) is in time exhausted. He conceives of this 'power' as being diminished at each successive step, much as we hold that in all exchange of energy between two systems there is a dissipation of some energy into a form unavailable for 'work'; consequently he holds that after a finite succession of steps, you come to some stage in the process at which a movent *X* passes on to a contiguous *Y* merely motion without the 'power to set another thing in motion'. *Y* is then the last term of the series of 'things set in motion' (τέλος δὲ παύεται, ὅταν μηκέτι ποιήσῃ τὸ πρότερον κινοῦν, ἀλλὰ κινούμενον μόνον. [N.B. τὸ πρότερον is of course nom.] ταῦτα δ' ἀνάγκη ἅμα παύεσθαι, τὸ μὲν κινοῦν τὸ δὲ κινούμενον, καὶ τὴν ὅλην κίνησιν, ib. 267ᵃ 9–12). Subject to the modification that what is passed on at each stage, until the last, is not simply movement but 'power to impart motion', Ar. accepts περίωσις, or as he calls it ἀντιπερίστασις, as a real process which happens in fluids (διὸ ἐν ἀέρι καὶ ὕδατι γίνεται ἡ τοιαύτη κίνησις, loc. cit. 267ᵃ 15). The point he is anxious to labour is that analysis shows that it cannot go on for ever. This, as well as the consideration that it is not strictly 'continuous', but composed of a denumerable series of pushes, distinguishes it in kind from the eternal and strictly continuous revolutions of the 'heavens'. He is anxious that no one shall try to explain *them* in 'naturalistic' fashion by περίωσις, because that would destroy his great argument for the existence of God, the argument that since the diurnal revolution of the ἀπλανές is continuous and eternal, it must have one eternal and unchanging author. περίωσις looks continuous but is not really so; 'it is a motion of things which are adjacent or in contact, for the source of motion in it is not one, but many things which form a serial order' (οὐ συνεχής, ἀλλὰ φαίνεται· ἡ γὰρ ἐφεξῆς ὄντων ἢ ἁπτομένων ἐστίν· οὐ γὰρ ἓν τὸ κινοῦν, ἀλλ' ἐχόμενα

ἀλλήλων, loc. cit. 267ª 13–15). Motion of ἀντιπερίστασις accordingly figures in Aristotle's own cosmology as a secondary and subordinate principle, useful chiefly for the explanation of certain facts of meteorology, such as changes of weather from wet to dry; apart from these applications the outstanding example of it in Aristotle is his physiological explanation of the rhythmic alternation of waking and sleep in the essay περὶ ὕπνου καὶ ἐγρηγόρσεως. Sleep is due to the fact that the blood gets regularly heated in the process of concoction of τροφή. It consequently gives off vapours (ἀναθυμιάσεις) of high temperature. These ascend until they reach the cold and moist brain. They are cooled there and redescend, and so induce a 'refrigeration' of the central organ, the heart, and its connexions, and thus cause unconsciousness. ὥστε φανερὸν ἐκ τῶν εἰρημένων ὅτι ὁ ὕπνος ἐστὶ σύνοδός τις τοῦ θερμοῦ εἴσω καὶ ἀντιπερίστασις φυσικὴ διὰ τὴν εἰρημένην αἰτίαν (op. cit. 457ª 33), and again τί μὲν οὖν τὸ αἴτιον τοῦ καθεύδειν, εἴρηται, ὅτι ἡ ὑπὸ τοῦ σωματώδους τοῦ ἀναφερομένου ὑπὸ τοῦ συμφύτου θερμοῦ ἀντιπερίστασις ἀθρόως ἐπὶ τὸ πρῶτον αἰσθητήριον (ib. 458ª 25).

80 a 3–b 8. καὶ ὅσοι φθόγγοι . . . παρέσχον. We come now to the most troublesome of the examples given by T., the attempt to account for musical concords and discords by the principle of περίωσις. First as to certain matters of grammar. A high-pitched and low-pitched note, we are told, are σύμφωνοι, concordant, when heard together δι' ὁμοιότητα τῆς ἐν ἡμῖν ὑπ' αὐτῶν κινήσεως, 'when the motion they produce in us is uniform', discordant δι' ἀνομοιότητα τῆς ἐν ἡμῖν ὑπ' αὐτῶν κινήσεως, 'when the motion produced in us is non-uniform'. That is, the notes are discordant when they give rise to 'beats'. Now arises a question about the grammar of the next sentence, τὰς γὰρ τῶν προτέρων κτλ. A.-H. *translates* on the assumption that the words ἤδη τε εἰς ὅμοιον ἐληλυθυίας mean ἤδη τε ἐληλυθυίας εἰς ὅμοιον ⟨ἐκείναις⟩ αἷς κτλ.; 'the slower sounds catch up the motions of the earlier and more rapid when these are already dying away and have come to a uniformity with the motions by which they themselves (the slower sounds) are moving them (the more rapid) afterwards as they advance' (this is not A.-H.'s actual language, but a strict 'construe' intended to bring out his view of the grammar). M. seems to take the same view from his rendering, 'les mouvements des sons les plus rapides, qui arrivent les premiers, diminuent, et sont déjà semblables à ceux des sons les plus lents, lorsque ceux-ci, arrivant plus tard, les agitent en les rattrapant', though the words are rather an ambiguous exegesis than a strict translation. So, too, apparently, Rivaud.

It is, however, equally possible grammatically to regard εἰς ὅμοιον as *absolute*, and to render 'the slower notes catch up the movements of the more rapid when they are already dying away and have come to a uniformity, by the motions with which they (the slower) move them (the more rapid)', thus making the 'understood' antecedent to αἷς not a dative after εἰς ὅμοιον but an instrumental dative. This seems to be what is meant by the rendering of Ficinus, 'priorum enim velociorumque cessantes motus, iamque *ad simile quiddam* progressos, tardiores ipsae voces succedentes illis, eosque moventes, occupant comprehendendo ac superant'. St. makes no comment to show how he construed the words.

With either construction and rendering we get the false suggestion that as the sounds 'die away' they also *ipso facto* 'come to a uniformity', i. e. that a dissonance becomes a consonance as it dies away. I do not think it possible to decide with certainty which construction is the true one. On the whole that commonly adopted seems to be the simpler, and I would therefore give it the preference and suggest that to avoid all possibility of ambiguity the comma traditionally printed after ἐλῃλυθυίας should be deleted. The meaning of the sentence, then, is this. A high and a low note are given out simultaneously, e. g. by two strings of a cithara. The higher note has the more rapid vibrations corresponding to it, and T. assumes that these vibrations are also propagated more rapidly through the air to our tympanum. The lower note has slower vibrations, and they are also propagated more slowly. By the time these reach our tympanum, the vibrations of the higher note have also slowed down, so that the effect of the overtaking of the higher note by the lower at the tympanum is not interference of wave-motions but a uniform wave-movement compounded of the two waves, and so we hear a consonance. The whole theory is quite perverse. For (1) in point of fact the rapidity of the vibrations set up by striking the wire is independent of the rate of their propagation through the air. Sounds of every pitch are propagated with the same velocity through the same medium. T. may be excused for not knowing this, but there is a less pardonable blunder. For (2) the 'dying away' of a note depends not on the slowing down of the *rapidity* of the corresponding vibrations but on the diminution of their *amplitude*, just as when a pendulum is coming to rest, the pendulum does not beat slower, but makes increasingly smaller excursions in the same period about the position of equilibrium. If the quicker vibrations really did 'slow down' to be 'caught up' by the others, obviously you would get this dilemma. If εἰς ὅμοιον ἰέναι means that they slow down to the *same* rate as the slower, the result would not be that we should hear two consonant or concordant notes, but that we should hear only one of augmented loudness. There would be nothing audible except either single tones or dissonances. If it is only meant that the faster vibrations slow down until they bear to the slower one of those simple ratios (2 : 1, 3 : 2, 4 : 3) on which the fundamental consonances are based, why should not the rates of vibration of the two notes have had this ratio from the first? Why need it be brought about by a 'slowing-down'?

As to the assumption that sounds of high pitch are transmitted through the same medium faster than those of lower pitch, Aristotle seems to make the same mistake in the chapter (*de Generatione Animal.* E. 7. 786^{b} 7 ff.) where he is trying to explain the differences in the cries of the various animals and the 'breaking' of the human male voice at puberty. Though he rightly points out that a voice may be at once high and loud or low and soft, he tries to account for both differences (that of pitch and that of loudness) by the difference between moving a greater or a less *volume* of air. A loud voice is one which moves an absolutely large volume of air, a deep voice one which moves a volume large *relatively* to the moving power. The strong can thus in some cases move a great volume of air but can only move it slowly, and then their voices are loud

but deep (*ἐὰν μὲν γὰρ ὑπερέχῃ τὸ κινούμενον τῆς τοῦ κινοῦντος ἰσχύος, ἀνάγκη βραδέως φέρεσθαι τὸ φερόμενον, ἂν δ' ὑπερέχηται, ταχέως. τὸ δ' ἰσχῦον διὰ τὴν ἰσχὺν ὁτὲ μὲν πολὺ κινοῦν βραδεῖαν ποιεῖ τὴν κίνησιν, ὁτὲ δὲ διὰ τὸ κρατεῖν ταχεῖαν*, loc. cit. 787ᵃ 15). The idea underlying this is that heavy things in general move more slowly than less heavy, if the motive force is the same in both cases. In the application of this Ar. is partly misled by a mere equivocation. He thinks of the 'deep' note as *heavy* because it was called *βαρύς* in Greek (Lat. *gravis*). But the employment of the argument from propulsion shows that he is also taking it for granted that the periodical vibrations set up in the air expelled through the vocal passages must be slow if the air is expelled slowly.

80 b 2–5. καταλαμβάνοντες δὲ . . . πάθην. That is, the 'overtaking' of the higher note by the deeper does not give rise to 'beats' and consequently to dissonance (*οὐκ ἄλλην ἐπεμβάλλοντες ἀνετάραξαν κίνησιν*). In the case of a consonance, the overtaken note is supposed already to have 'slowed down' to the same rate of vibration as the overtaking. The effect of being overtaken, therefore, is simply that the movement which was dying away gets a new lease of life. The overtaking motion supplies 'the starting-point of a slower movement uniform with (*κατὰ τὴν ὁμοιότητα*) that of the swifter but now dying' *κίνησις*. The result is a single 'quality' (*πάθη*) which is a blend of high and low, i. e. an *ἁρμονία*. The allusion is to the standing (Pythagorean) definition of *ἁρμονία* as a *κρᾶσις* of the high and the low. Cf. for the definition and its authors *Philebus* 17 c 11 *ἀλλ', ὦ φίλε, ἐπειδὰν λάβῃς τὰ διαστήματα ὁπόσα ἐστὶ τὸν ἀριθμὸν τῆς φωνῆς ὀξύτητός τε πέρι καὶ βαρύτητος, καὶ ὁποῖα, καὶ τοὺς ὅρους τῶν διαστημάτων, καὶ τὰ ἐκ τούτων ὅσα συστήματα γέγονεν—ἃ κατιδόντες οἱ πρόσθεν παρέδοσαν ἡμῖν τοῖς ἑπομένοις ἐκείνοις καλεῖν αὐτὰ ἁρμονίας κτλ.* There seems to be a hint that in the majority of cases the 'overtaking' of the one sound by the other happens before the *ὁμοιότης* has been reached, and that this is why only a few intervals are consonant. In the other cases the overtaking does lead to an interference of sound-waves which is disagreeable to us.

80 b 5–8. ὅθεν ἡδονὴν . . . παρέσχον. For the contrast between *ἡδονή* and *εὐφροσύνη* cf. *Protagoras* 337 c 1, where it is dwelt on by Prodicus, *ἡμεῖς τ' αὖ οἱ ἀκούοντες μάλιστ' ἂν οὕτως εὐφραινοίμεθα, οὐχ ἡδοίμεσθα—εὐφραίνεσθαι μὲν γὰρ ἔστιν μανθάνοντά τι καὶ φρονήσεως μεταλαμβάνοντα αὐτῇ τῇ διανοίᾳ, ἥδεσθαι δὲ ἐσθίοντά τι ἢ ἄλλο ἡδὺ πάσχοντα αὐτῷ τῷ σώματι.* It looks as though there had been an attempt in the fifth century to specialize the word *ἡδονή* by confining it to the sphere of what Plato calls 'bodily' pleasures, and to give the name *εὐφροσύνη* to the strictly mental pleasures of intellect, imagination, and affection. Plato himself rightly regarded *ἡδονή* as a generic name for both species, as the terminology of the *Philebus* and *Laws* proves. In the *Protagoras* he is amusing himself by parodying the rather pedantic discriminations of synonyms made by Prodicus.

80 b 6–7. διὰ τὴν τῆς θείας . . . φοραῖς. The meaning is that what gives such special delight to the *ἔμφρονες* is that music is 'audible mathematics'. The *θεία ἁρμονία* meant is the simple mathematical ratio which corresponds to a consonance. This is 'eternal' or 'timeless', and hence

θεία. The 'heard melody' reproduces an arithmetical ratio in a certain 'matter', the vibrations of cords or strings, which are *γιγνόμενα*. The knowledge that consonance depends on ratios serves as an incentive to the mind to study the relations of numbers as such; *μουσική* forms the starting-point for the whole study of series. Cf. *Rep.* vii. 531 c 1, where Socrates blames the ordinary run of students of *ἁρμονίαι* because *τοὺς ἐν ταύταις ταῖς συμφωνίαις ταῖς ἀκουομέναις ἀριθμοὺς ζητοῦσιν, ἀλλ' οὐκ εἰς προβλήματα ἀνίασιν, ἐπισκοπεῖν τίνες σύμφωνοι ἀριθμοὶ καὶ τίνες οὔ, καὶ διὰ τί ἑκάτεροι*. It is probably these same *μουσικοί* rather than the more general public whom Timaeus here speaks of as *ἄφρονες*, just as Socrates (loc. cit.) speaks of them as *ὦτα τοῦ νοῦ προστησάμενοι*.

80 b 8. καὶ δὴ καὶ τὰ τῶν ὑδάτων πάντα ῥεύματα. Timaeus contents himself here with the mere general statement that the flowing of water down-hill is a case of *περίωσις*. How the *περίωσις* in this case is effected is explained by Plutarch *Plat. quaest.* 1005 d–1006 a. We must not suggest that 'gravity' is 'perhaps tacitly assumed'. The whole reason why there is any problem at all to be solved by *περίωσις* is that T. agrees with fifth-century physicists in general in making no use of *weight* as a principle of explanation. Plutarch admits that it is not very easy to follow the details of the *περίωσις* in this case (*ἡ δὲ τῶν ἐπὶ γῆς ὑδάτων ῥύσις οὐχ ὁμοίως εὐσύνοπτον ἔχει τὸν τῆς ἀντιπεριώσεως τρόπον*), but works it out as follows. Standing water (*τὰ λιμναῖα*) is calm and unruffled (*ἀτρεμοῦντα καὶ μένοντα*) unless its surface is agitated by movements of the air with which it is in contact. When this air is disturbed the surface of the water is set in violent motion (*δονεῖται καὶ κυμαίνεται*). Disturbance in the air leads to motion in the water which is thus set flowing. The flow of a river gives a push to the air in front of it, and this to a *περίωσις* which leads to a fresh push of the air on the water from behind, and thus keeps up the flow of the river (*αἱ ῥύσεις οὖν τῶν φερομένων ἀεὶ τὰ ὑποχωροῦντα τοῦ ἀέρος διώκουσαι, τοῖς δ' ἀντιπεριωθουμένοις ἐλαυνόμεναι, τὸ ἐνδελεχὲς καὶ ἀλώφητον ἔχουσι*). Hence the fuller the stream, the more rapid the current, but when the stream is low there is no need of a very violent *ἀντιπερίστασις* (loc. cit. 1005 f). Observe the manifest confusion between greater momentum and greater velocity. Plut. quite forgets that there may be a great volume of water with no appreciable current, or a very small volume with a swift current. So the water of a spring is forced upward by air from above which penetrates the hollows deep in the earth and pushes up the water from them (*τοῦ θύραθεν ἀέρος εἰς τὰς κενουμένας ἐν βάθει χώρας ὑποφερομένου καὶ πάλιν θύραζε τὸ ὕδωρ ἐκπέμποντος*, ib.). We are to understand that the driving up of the water causes a *περίωσις* by which more air is forced down into the *βάθη*; by steady repetition of this circular process we get a constant stream of water forced upwards. Plutarch does not expressly say what makes a river *begin* to flow, but we may infer that it is the agitation of the lake or pool from which it comes by currents of air.

80 c 1–2. καὶ τὰ θαυμαζόμενα . . . λίθων. The 'attraction' of the loadstone and of amber. Note the curiously artificial order of the words, *τῶν* 'H. *λίθων*, depending like *ἠλέκτρων* on *ἕλξεως*, so that the construction is *τὰ θαυμαζόμενα περὶ τῆς ἕλξεως ἠλέκτρων καὶ τῶν* 'H. *λίθων*. The whole

sentence is anacoluthic, the construction changing at *πάντων τούτων*, so that *ῥεύματα, πτώματα, τὰ θαυμαζόμενα* are left 'pendent' nominatives. The point of T.'s electro-magnetic theory, if we may call it so, is again that what appears to be *ἕλξις*, 'attraction' is really 'pulsion'. There is no 'pull' of the loadstone on the iron. Plutarch explains the process thus (op. cit. 1005 b–d). Certain violent effluxes of air are emitted by the loadstone (*ἡ μὲν λίθος τινὰς ἀπορροὰς ἐξίησιν ἐμβριθεῖς καὶ πνευματώδεις*); these push the air in front of them and this in turn the air in front of it. In the end a push of the air is thus set up behind the iron, and this drives it towards the loadstone. A similar account is offered of amber. Rubbing the amber forces out something in the nature of wind or fire (*τὶ φλογοειδὲς ἢ πνευματικόν*) from its *πόροι*, and the rest of the process goes on exactly as with the loadstone and the iron. It still remains, of course, to explain why the loadstone attracts only iron and not anything else. A.-H. does not report Plutarch quite correctly on this point. His account is that iron is the only body whose pores are so exactly proportioned to the size of the particles of air that the air getting into them has quite the right hold or 'purchase' on the iron; *ὁ σίδηρος οὔτ' ἄγαν ἀραιός ἐστιν ὡς ξύλον, οὔτ' ἄγαν πυκνὸς ὡς χρυσὸς ἢ λίθος, ἀλλ' ἔχει πόρους καὶ οἴμους καὶ τραχύτητας διὰ τὰς ἀνωμαλίας τῷ ἀέρι συμμέτρους, ὥστε μὴ ἀπολισθάνειν ἀλλ' ἕδραις τισὶν ἐνισχόμενον καὶ ἀντερείσεσι περιπλοκὴν σύμμετρον ἐχούσαις, ὡς ἂν ἐμπέσῃ πρὸς τὴν λίθον φερόμενος, ἀποβιάζεσθαι καὶ προωθεῖν τὸν σίδηρον* (op. cit. 1005 d. Nothing is said about the necessity of the return to the loadstone of the special *quality* of air which was emitted from it. A.-H. seems to have added this *de suo*). Since the *συμμετρία* of particles with *πόροι* plays a prominent part not only in the theories of Timaeus but in the sense-physiology of Empedocles, this explanation is at least on the right lines. Plutarch does not mention the source of any of his explanations, but as his various essays show him to have been well-read in the literature of the subject and to have been directly or indirectly acquainted with the explanations of or commentaries on the *Timaeus* by Xenocrates, Crantor, and Posidonius, probably some of these are responsible for what he says.

Very little seems to be known about the theories of the early physicists on the subject of the loadstone, except that its curious property of attracting iron had been already observed by Thales, who is credited by Aristotle with having said that it must be alive (presumably because it seems to exhibit *προαίρεσις*, or at any rate *ὄρεξις*). Empedocles is known to have offered a theory of the matter which is reported (probably on the strength of the great work of Theophrastus *περὶ φυσικῶν δοξῶν*), by Alexander of Aphrodisias, *Quaest. Natural.* ii. 23 Bruns. p. 72 (= Diels *Fr. d. Vors.*[5] i. 221). E. said that 'the effluxes from the loadstone repel the air at the entrance of the pores of the iron, and when this is eliminated the iron follows the violent efflux from its own pores. The effluxes from it enter the pores of the loadstone, being proportioned to them, and fit into them, and the iron is borne along with these effluxes' (*αἱ μὲν γὰρ ταύτης ἀπόρροιαι τὸν ἀέρα τὸν ἐπὶ τοῖς τοῦ σιδήρου πόροις ἀπωθοῦσί τε καὶ κινοῦσι τὸν ἐπιπωματίζοντα αὐτούς· τούτου δὲ χωρισθέντος ἀθρόᾳ ἀπορροίᾳ ῥεύσῃ τὸν σίδηρον ἕπεσθαι· φερομένων δὲ τῶν ἀπ' αὐτοῦ ἀπορροιῶν ἐπὶ τοὺς τῆς λίθου πόρους,*

διὰ τὸ συμμέτρους τε αὐτοῖς εἶναι καὶ ἐναρμόζειν καὶ τὸν σίδηρον σὺν ταῖς ἀπορροίαις ἕπεσθαί τε καὶ φέρεσθαι). This seems to be identical with the doctrine of Timaeus as explained by Plutarch. *Timaeus Locrus* (102 a) gives the same explanations of the cupping-glass and the adhesion of straws to the amber as Plutarch. Hobbes persisted, in the third quarter of our seventeenth century, in a very similar theory about the loadstone. See *Decameron Physiologicum* ix (Molesworth vii. 156) in which he tries to prove that the 'air between the loadstone and the iron' is 'cast off' and 'consequently the place left empty, if the iron did not rise up and fill it'.

Aristotle, as we have seen, alludes to T.'s explanation of magnetism in the criticism of the theory of περίωσις at the end of *Physics* Θ. From the language of his allusion it looks as though he himself acquiesced in the use of περίωσις to explain this particular 'appearance', but there is no discussion of magnetism and only one or two passing allusions to the loadstone itself anywhere in the Aristotelian corpus. Nor does the subject seem to have interested the Stoics, so far as we can tell. Lucretius (vi. 906–1089) has a long passage on the loadstone which displays even more than his usual incapacity for coherent thinking. In the main, when he comes to the problem why the loadstone 'attracts' iron (loc. cit. 998–1041), he merely repeats the view of Empedocles and Timaeus without understanding it. 'Particles' (*semina*) of some kind escape from the loadstone and 'beat away' the air between it and the iron, so making a vacuum. Atoms of the iron move into this vacuum, and the consistency of iron is such that this entails a movement of the whole mass. The movement is reinforced by the pressure of the air 'behind' the iron, which drives it forward in a direct line to the loadstone. Why this thrust of the 'air behind' does not simply lead to a draught of the air itself through the πόροι of the iron, L. never explains. Obviously this is only the περίωσις reproduced without understanding that the sole motive for bringing a περίωσις into the matter was that Empedocles and Timaeus denied that very existence of *vacuum* on which Epicurus and Lucretius insist. Lambinus thought that the close agreement of much of the passage with the *Timaeus* proved Lucretius to have had the Platonic dialogue before him. As L. elsewhere (iv. 1160 ff.) imitates the famous passage *Rep.* 474 d–e, this is quite possible, but it is just as likely that he may be directly copying his own poetical model, Empedocles.

It may be worth while to quote the penetrating comment of Galileo on the attempt to account for the continuous motion of projectiles, &c., by anteperistasis (*Dialogo* ii. [ed. 1710, p. 146]). He has just shown that an arrow pierces the air in its flight and continues, 'Adunque le freccie tirate hanno a penetrar l'aria? O se l'aria và con loro, anzi è quella che le conduce, che penetrazione vi può essere? Non vedete voi, che a questo modo bisognerebbe che la freccia si movesse con maggior velocità che l'aria? E questa maggior velocità, chi la conferisce alla freccia? Vorrete voi dire che l'aria le dia velocità maggiore della sua propria?'

80 c 2. τῶν Ἡρακλείων λίθων. The stone was also known as Μαγνῆτις (Eurip. *Oeneus* Fr. 571), though Plato (*Ion* 533 d), referring to this passage made Socrates say that Ἡρακλεία λίθος was the common expres-

sion, and σιδηρῖτις, the 'iron' stone. The name 'Heraclean' was commonly supposed in ancient times to mean 'from Heraclea', but it may equally well mean, as has been sometimes suggested, 'Herculean', from the powerful attraction the loadstone exerts.

80 c 2–3. πάντων τούτων . . . οὐδενί ποτε. This is the most explicit enunciation of the principle rejected by Galen that all 'pulls' are to be resolved into 'pushes'.

80 c 3–8. τὸ δὲ κενὸν . . . φανήσεται. The grammar here is difficult. How are we to construe the infinitives εἶναι, περιωθεῖν, ἰέναι? Stephanus wished to emend the τό of c 3 and τό τε of c 4 to τῷ and τῷ δέ so that the infinitives would be instrumental datives and the subject of φανήσεται would be ἕκαστα πάντα. 'Because there is no void, but a mutual circular pulsion, and because all and each of these things in their combinations and dissolutions are moving to their own places, they (sc. ἕκαστα τούτων) will appear as wonderful in virtue of their mutual complications.' St., though not altering the text, apparently approves, as his only comment is 'non male'. A.-H. also thinks that 'the text can hardly be sound'. M.'s version is periphrastic, and he makes no comment. The conjecture, besides having no adequate MS. justification, seems to me to yield a bad sense. It is just the man who has grasped the explanation to whom the appearances will *not* seem τεθαυματουργημένα, 'magical', 'effects of wizardry'. φανήσεται should not mean 'will appear' but 'will be plain'. This is how A.-H. and M. *translate*, but they do not explain how they construe. I take it that the infinitives are all subjects of φανήσεται, and that the words τούτοις . . . τεθαυματουργημένα are a participial clause to be taken with ἰέναι; 'but to him who investigates rightly it will be apparent that there is no void and that the things in question exercise a circular pulsion on one another and move by combinations and dissolutions each to their varying abodes in ways which seem magical in virtue of these reciprocal complications'. To make the construction plain it would be well to insert a comma after τεθαυματουργημένα. A.-H. well compares *Laws* 893 d 1 ff. ἡ τοιαύτη κίνησις ἀνὰ λόγον ἑαυτὴν διανέμει σμικροῖς τε καὶ μείζοσιν, ἐλάττων τε οὖσα καὶ πλείων κατὰ λόγον· διὸ δὴ τῶν θαυμαστῶν ἁπάντων πηγὴ γέγονεν, ἅμα μεγάλοις καὶ σμικροῖς κύκλοις βραδυτῆτάς τε καὶ τάχη ὁμολογούμενα πορεύουσα, ἀδύνατον, ὡς ἄν τις ἐλπίσειε, γίγνεσθαι πάθος.

80 c 3. τὸ δὲ κενὸν εἶναι μηδέν. We have already seen that the discrepancy between this assertion, which belongs to the Empedoclean cosmology and physiology of T., and his original physical construction of the four bodies, which is of Pythagorean origin, must not be explained away.

80 c 5. πρὸς τὴν αὐτῶν διαμειβόμενα ἕδραν. The explanations just given depend on two principles of which the non-existence of τὸ κενόν is only one. That explains why a movement anywhere leads to a περίωσις. Why the initial movement takes the direction it does is explained by the Empedoclean theory of the tendency of small aggregates towards larger aggregates of the same kind.

80 d 1—81 a 4. καὶ δὴ καὶ τὸ τῆς ἀναπνοῆς . . . πρὸς ἑαυτό. Timaeus returns to his unfinished account of respiration, the preceding section

about other examples of *περίωσις* being a digression. He wishes to complete his statement about the mechanics of respiration by a fuller account of the way in which the process leads to the formation of blood, and so to the nourishment and growth of the whole body. The 'fire' conveyed into the body by the motion of the *κύρτος* and its contents penetrates and divides up the food which has been received into the stomach, and since this 'fire' follows the motion of the containing *κύρτος* of air as it swings up and down, it pumps the nutriment, now cut up small (in fact, the 'chyle'), into all the blood-vessels, and so the whole body receives a steady flow of nutriment for its tissues.

80 d 3. αἰωρουμένου. There is no need, with Hermann, to alter the case of the participle to the dative. The oscillatory movement was ascribed at 78 d 1 to the *κύτος τοῦ κύρτου* (made of air), but it is communicated to the fire contained in the *κύτος*, which may therefore be said to 'oscillate within the body in accompaniment with the breath', exactly as the 'fire' is said at 78 d 7 *ἀκολουθεῖν ἐφ' ἑκάτερα ἰόντος τοῦ ἀέρος*; cf. 78 e 5 *ὁπόταν εἴσω καὶ ἔξω τῆς ἀναπνοῆς ἰούσης τὸ πῦρ ἐντὸς συνημμένον ἕπηται*. There is a certain obscurity in the whole theory. The movements of the 'fire' within the body are first spoken of as if they were consequences of the movements of the *πνεῦμα*, but in 79 d 4 ff., where the exhalation of air at mouth and nose is being explained, the movement of the breath seems to be accounted for as an effect of the tendency of 'fire' to 'fire'. This difficulty, however, cannot be eliminated by emendation; it is part of the incoherency of the whole theory.

80 d 5. ἐπαντλεῖν. The metaphor of the irrigation of the kitchen-garden is resumed here and in the *νάματα* and *ἐπίρρυτα* of d 7. The theory is that the 'fire' begins its work by 'mincing' the contents of the *κοιλία* small. It can do this in virtue of the sharp points and edges of its pyramidal particles. Blood is just a 'mince' of the contents of the *κοιλία*. Then in its onward movement the 'fire' further opens the 'sluices' and drives the blood so formed through all the 'channels' and 'conduits' which have been cut for its reception.

80 d 7. γέγονεν. The indicative, formerly admitted by some editors apparently with no good MS. authority, is now known to be the reading of F, and should be adopted as the *vera lectio*.

80 d 7–e 4. νεότμητα . . . φύσις. The small particles of fruit and cereals are of all colours, but the general effect is that the whole looks red as a consequence of the action of fire on a moist material. This fits in with the account given of *ἐρυθρόν* at 68 b as the colour of fire gleaming through moisture. The unexpressed subject of the sentence is the *τετμημένα* of d 5, the 'mince' made by the fire. *νεότμητα* is significant. If the cereals, &c., were dry and not fresh, there would be less variety of tints. For *συγγενῶν* see n. on *συγγενῆ*, 77 a 4. The present passage must be taken as emphatically asserting that the natural and proper diet of man is strictly vegetarian. T.'s agreement with Empedocles makes it natural that he should adopt that philosopher's views on the point.

80 e 2. ἴσχει. Not 'have' but 'get'. The blending of particles of different colours *gives rise to* a still greater variety of tints, but the prevailing effect is that of red.

80 e 4. δεδημιουργημένη φύσις. This, as against the variants found in Galen and Stobaeus, is plainly the archetypal reading, as is shown by the agreement of A W Y with F. The words are in apposition with *ἡ ἐρυθρὰ χρόα*, 'red, the character (*φύσις*) produced by, resulting from, the cutting and printing off of itself by fire on moisture'. Grammatically *τομῆς* and *ἐξομόρξεως* are defining genitives after *φύσις*, *δεδημιουργημένη* having no influence on the construction.

80 e 4—81 a 2. ὅθεν . . . βάσιν. The traditional punctuation puts a full stop at *διεληλύθαμεν*, thus making *ὃ καλοῦμεν αἷμα*, 'this we call blood', a separate sentence. *τὸ χρῶμα* must then be taken as a nominative, 'hence the colour of what flows through the body got the appearance we have described'. But *αἷμα* is not the only fluid which *ῥεῖ κατὰ τὸ σῶμα*; *ἀήρ*, for instance, does the same (78 d 3–4). Hence Bt.'s punctuation should be followed, and *τοῦ . . . ῥέοντος* should be taken as *partitive*. It is a less certain point what the case of *χρῶμα* is, but, in view of the *παντοδαπὰ χρώματα ἴσχει* immediately above, it should probably be regarded as accusative, so that the meaning is, 'hence that (part) of the fluid flowing in the body which we call blood got the colour with the appearance just described', 'got the look we have described, in respect of its colour'. The 'humours' of which we are to hear more also *ῥεῖ κατὰ τὸ σῶμα* (as is indicated by the very word *catarrh*), but they are not blood-coloured. *ὑδρευόμενα* keeps up the metaphor of the kitchen-garden [1] and *βάσιν*, as A.-H. says, means that on which anything stands or rests. The thought is that the daily waste of tissue is repaired by the building up of fresh tissue out of the blood circulating through the system. Hence blood is called the *νομή* or 'pasturage' of the body as a whole.

81 a 2–e 5. ὁ δὲ τρόπος . . . ἡ λύπης. *Growth, decay, and death.* Growth is first explained on the analogy between macrocosm and microcosm. As in the *οὐρανός* there is a perpetual tendency for each 'root', if left to itself, to move towards its 'kindred' aggregate, so it is with the particles of the different 'roots' of which 'what we call blood' is an amalgam. They tend to be sorted out, each to its congeners, in the 'little world' of the human organism, and just as the 'vibration of the *ὑποδοχή*' in the *οὐρανός* is perpetually shifting the direction which is 'towards the cognate', so it is with the organism. The result is that whatever is deficient in any part is steadily supplied from the blood. This is meant to explain how such different things as bone, sinew, flesh all get just what they need to repair waste in them supplied in the right proportions by one and the same cause, the circulation of the blood. Timaeus has before him the same problem which is faced by Anaxagoras when he observes (Fr. 10) *πῶς γὰρ ἂν ἐκ μὴ τριχὸς γένοιτο θρὶξ καὶ σὰρξ ἐκ μὴ σαρκός*; (cf. Aetii *Placita* i. 3. 5 [*Doxogr. Graec.* 279] = R. P. 155 f *τροφὴν γοῦν προσφερόμεθα ἁπλῆν καὶ μονοειδῆ, ἄρτον καὶ ὕδωρ, καὶ ἐκ ταύτης τρέφεται θρὶξ φλὲψ*

[1] For the metaphor cf. Hippocr. *περὶ σαρκῶν* (or *ἀρχῶν*), Kühn i. 435 *ἀρδόμενα γὰρ ὑπὸ τῆς τροφῆς αὔξεται ἕκαστα, τὸ θερμὸν καὶ τὸ ψυχρὸν καὶ τὸ κολλώδες καὶ τὸ λιπαρὸν καὶ τὸ γλυκὺ καὶ τὸ πικρὸν καὶ τὰ ὀστέα καὶ τὰ ἄλλα ξύμπαντα ὁκόσα ἐν τῷ ἀνθρώπῳ ἔνῃ* (but l. *ἔνι*). So *περὶ χυμῶν* (Kühn i. 128–9) *ὥσπερ τοῖσι δένδροισιν ἡ γῆ, οὕτω τοῖσι ζωοῖσιν ἡ γαστὴρ καὶ τρέφει καὶ θερμαίνει καὶ ψύχει. ψύχει μὲν κενουμένη, θερμαίνει δὲ πληρουμένη. ὥσπερ γῆ κοπρευομένη χειμῶνος θερμή, οὕτω καὶ ἡ κοιλίη.*

ἀρτηρία νεῦρα ὀστᾶ καὶ τὰ λοιπὰ μόρια). T.'s corpuscular physics would not allow him to regard the τροφή as ἁπλῆ καὶ μονοειδής, but he still has to face the problem how just those constituents of αἷμα which are needed are distributed to the very various tissues of the body in just the right proportions. The important point is that the anabolic and catabolic processes in the organism are to be explained by the tendency of 'like to like' which we have already met in our cosmology.

81 a 5. ἡμᾶς. Presumably to be taken as 'governed' ἀπὸ κοινοῦ by both περιεστῶτα and τήκει, 'our external environment is steadily wasting us'.

81 a 5–6. πρὸς ἕκαστον εἶδος τὸ ὁμόφυλον ἀποπέμποντα. In strictly classical Attic ὁμόφυλον would be a fanciful and poetical equivalent for συγγενές; the use of it here is one of the many echoes of the style of fifth-century Ionic scientific prose to be found in the language of Timaeus, and is, no doubt, so intended. Cf. Hippocr. περὶ φύσιος ἀνθρώπου (Kühn i. 351) ἂν μὴ ὁμόφυλα ἐόντα μίσγηται καὶ τὴν αὐτὴν ἔχοντα δύναμιν γεννᾷ, οὐδ' ἂν ταῦτα ἡμῖν συντελέοιτο; 'Philolaus' Fr. 6 = R. P. 67 ἐπεὶ δὲ ταὶ ἀρχαὶ ὑπῆρχον οὐχ ὁμοῖαι οὐδὲ ὁμόφυλοι ἔσσαι . . . τὰ δὲ ἀνόμοια μηδὲ ὁμόφυλα μηδὲ ἰσολαχῆ ἀνάγκα τᾷ τοιαύτᾳ ἁρμονίᾳ συγκεκλεῖσθαι, οἷᾳ μέλλοντι ἐν κόσμῳ κατέχεσθαι; so Theophrastus quotes from Democritus the formula that 'like is known by like' in the words τὰ γὰρ ὁμόφυλα μάλιστα ἕκαστον γνωρίζειν (*de Sensu* 50, *Doxogr. Graec.* 513 = *Fr. d. Vors.*[8] ii. 41).

ib. **τὰ δὲ ἔναιμα.** Not the 'particles of blood' but quite literally 'the things in the blood', 'the contents of the blood'. The blood throughout is taken to *be* nutriment which has been 'cut up' by the dividing action of fire into its constituent corpuscles of air, water, &c. It is the particles of these 'roots' which, according to T., are distributed πρὸς τὸ ὁμόφυλον, 'earth to earth', 'water to water', and the like. This explains how the daily waste is made good in the body.

81 a 7–8. ὥσπερ ὑπ' οὐρανοῦ . . . ζῴου. Formerly we had the human head specially likened to the οὐρανός on account of its approximately spherical shape. We now learn that more generally the whole living organism stands to the τροφή it contains as the οὐρανός in the specially Pythagorean sense, the 'outermost circle' of heaven, does to all that it contains.

We are now to see the explanation of the very rapid growth of the infant's body, the slower growth of later years, the transition from youth to age, the period in which αὔξησις is replaced by φθορά, and the final dissolution at death. Growth continues as long as the volume of new tissue supplied is in excess of the volume lost, i.e. so long as organic repair outruns organic waste, and no longer. While a creature is young and the 'triangles' of which its corpuscles are built up fresh, though its frame is soft and tender, being constructed out of still young μυελός and fed on milk, the triangles are very closely rivetted together (81 b 5–c 2).

81 b 6–7. καινὰ . . . γενῶν, i.e. ἔχουσα καινὰ τὰ τρίγωνα τῶν γενῶν οἷον ἐκ δρυόχων. The γένη are the four corpuscles of the four 'roots', and the τρίγωνα their component triangles. The metaphor of the οἷον ἐκ δρυόχων should be noted; 'having the triangles of its materials fresh

from the slips'. The organism is thought of as a newly-launched ship whose planks are as yet wholly 'unstarted' by heavy weather. We have just been dwelling on the fact that the living body is a lesser *οὐρανός*, and this reminds Timaeus of the old Pythagorean comparison of the *οὐρανός* with a ship with God for its captain. If the great *οὐρανός* is a ship, so is the lesser. So the *σύγκλεισι* of b 7 keeps up the same picture. The planks of the ship fresh from the slips are well locked together; it has not yet started a seam anywhere. Hence it is easy for the triangles of the body to control the older and more worn triangles of the *τροφή* (which have *inter alia* just been subjected to the violent action of the internal 'fire'), and to work them well into the framework of the organism. *συμπέπηγεν* is, of course, also part of the nautical metaphor. On *δρυόχων* cf. Rogers's note on Aristoph. *Thesmophor.* 52.

For the conception of the *οὐρανός* as a ship the *locus classicus* in Plato is in the myth of the *Politicus* 272 e 3 *τότε δὴ τοῦ παντὸς ὁ μὲν κυβερνήτης, οἷον πηδαλίων οἴακος ἀφέμενος, εἰς τὴν αὑτοῦ περιωπὴν ἀπέστη, τὸν δὲ δὴ κόσμον πάλιν ἀνέστρεφεν εἱμαρμένη τε καὶ σύμφυτος ἐπιθυμία κτλ.* We even learn here what are the waters in which the ship voyages, 273 d 6 *τὸν τῆς ἀνομοιότητος ἄπειρον ὄντα πόντον*, i. e. the 'sea' is our old friend the 'boundless' in which the various *κόσμοι* are like vessels sailing on different tracks. The famous *ὑποζώματα* of the myth of Er (*Rep.* x. 616 c 3) belong to the same set of ideas. The connexion with Pythagoreanism is proved by the fact that the Pythagoreans spoke of the 'central fire' as the 'keel' of the *οὐρανός*. (Aetius *Placita* ii. 4. 15, *Doxogr. Graec.* 332 = R. P. 73 a (Φιλόλαος) *τὸ ἡγεμονικὸν ἐν τῷ μεσαιτάτῳ πυρί, ὅπερ τρόπεως δίκην προυπεβάλετο τῇ τοῦ παντὸς* ⟨*σφαίρᾳ*⟩ *ὁ δημιουργὸς θεός.* So in 'Philolaus' Fr. 12 = R. P. 79, the dodecahedron is called *τᾶς σφαίρας ὁλκάς*, the 'hull' of the sphere. Cf. *EGPh.*[3] 294 n. 1, 2, 3.)

81 c 6–d 4. *ὅταν δ' ἡ ῥίζα . . . τὸ πάθος.* In later life the 'root of the triangles' is 'slackened', 'started' (*χαλᾷ*) by many a combat. (The language still depends on the metaphor of the ship. The many *ἀγῶνες* are the buffetings the ship has taken from wind and wave, and the *χαλᾷ* means that the seams have 'started'. A.-H.'s 'are blunted' obscures the picture and seems also to embody the impossible view of M. that the *ῥίζα* of a triangle means an angular point.) The consequence of this is that the triangles of the organism can no longer 'cut up' those of the *τροφή* into uniformity with themselves, but are themselves broken up by the *τροφή*. That is, organic waste can no longer be made good; it outruns repair, and this is precisely what we mean by *γῆρας*, 'old age'. The one difficulty in the passage is the interpretation of the curious phrase, *ἡ ῥίζα τῶν τριγώνων*. St. in his note translates by 'primitiva illa trigona'. I take it this means he regarded *τῶν τριγώνων* as a defining genitive, 'the root formed by the triangles'. (He *might* mean by the *primitiva trigona* the 'half-triangles' or 'half-squares' of which the faces of the corpuscles are in the last resort composed, but if he had intended this it is presumable that he would have said so.) M. says, without more ado, *la pointe*, thus supposing the *ῥίζα* of a triangle to mean one of its angular points. I do not believe Plato could have expected to be understood if he had spoken of an angular point in such a way without explanation. A.-H.,

perhaps remembering the common mathematical custom of calling the sides and angles of a triangle its 'elements', says in his note that the ῥίζα is the 'sides and angles'. This virtually amounts to agreement with St. about the sense. Yet in his translation A.-H., like M., misrenders χαλᾷ, 'are blunted'. This ought to imply M.'s view of what is meant by the ῥίζα (for how do you 'blunt' a *side* of a figure?). The phrase is obscure, but however we translate it, our rendering should be consistent with the view that the effect of the storms the ship has weathered is that something 'is slackened', 'starts' (χαλᾷ). Now at 84 b 1 we find T. speaking of the attachments of the flesh to the bones as the ῥίζαι of the flesh, and this suggests that the ῥίζαι of the 'triangles' ought in the same way to mean the attachments of the triangles which compose a corpuscle to one another, i.e. the lines along which the faces of the corpuscle are joined. That is, the ῥίζαι τῶν τριγώνων will mean their sides, the 'edges' of the various solids which are the corpuscles. I do not see what else can be meant as a point of language, and the interpretation suits T.'s general physical theory, according to which the 'breaking up' of a corpuscle always takes place by resolution of it into its constituent triangles. This makes the metaphor of χαλᾷ natural. A corpuscle which is yielding to forces which will resolve it into its triangles is compared with a part of the planking of a boat where the seams are starting. Thus I believe M. was right in looking for the ῥίζαι among the 'elements' of the triangles, but unfortunately chose the wrong elements, the angles, when he should have chosen the sides. The meaning, then, will be that in old age the σύγκλεισις of b 7 above is relaxed. When the triangular faces of the corpuscles, which are the planking of the 'ship', begin to 'spring leaks', the vessel is overpowered by the torrent of incoming τροφή, the sea-water gets in, and the corpuscles of the organism are broken up by it. The culmination is reached in death, when this process has actually reached the corpuscles of the μυελός and the 'attachments of the ψυχή' themselves 'let go'.[1]

81 d 5–e 2. *Natural death.* The end of the process of φθορά comes when the μυελός itself gives way. When its corpuscles are resolved into their 'triangles', they in turn let go the (purely metaphorical) δεσμοὶ τῆς ψυχῆς of which we read in 73 b. (We must not try to find anything anatomical to answer to *these* δεσμοί.) The process is painless, or even pleasant, when it occurs gradually and in the course of nature (death from gradual senile decay); it is painful when it is sudden and violent and out of the normal course (death from wounds or disease).

81 d 5–6. τῶν περὶ τὸν μυελὸν . . . διιστάμενοι. The δεσμοί or 'attachments' of the 'triangles in the μυελός' are simply the edges of the corpuscles which compose it, i.e. they are the ῥίζαι of these triangles. τῷ πόνῳ = 'under the stress'. The word is part of the naval metaphor. The πόνος meant is that of the vessel whose planks are being strained. It does not mean 'pain' felt by the dying man, since we are immediately told that in *natural* death there is no pain, it is ἀπονώτατος τῶν θανάτων.

[1] Fraccaroli seems to understand the general sense much as St. does, 'credo si devano intendere semplicamente i triangolari originari dell' individuo'. But I do not see how he makes 'the root of the triangles' mean 'the triangles of the human race'.

διιστάμενοι, since it is now known to be the reading of F W, is certainly the genuine reading here, and the discussion of the possibility of A.'s διεστάμενοι is happily unnecessary.

Aristotle's theory of natural death is not very different. T. makes death from old age a direct consequence of the failure of the triangles to cut up the τροφή (the special function of the 'fire' in the organism). Aristotle also holds that its cause is the failure of natural heat (*de Iuventut.* 478b 32 πᾶσι μὲν οὖν ἡ φθορὰ γίνεται διὰ θερμοῦ τινος ἔκλειψιν, τοῖς δὲ τελείοις, ἐν ᾧ τῆς οὐσίας ἡ ἀρχή. But he accounts for this failure of vital heat in a way of his own. The vital fire goes out when it is not properly 'refrigerated', because then it completely consumes its own fuel, like a fire in a brazier from which air is carefully excluded (op. cit. 479a 7 ἡ δ' ἀρχὴ τῆς ζωῆς ἐκλείπει τοῖς ἔχουσιν, ὅταν μὴ καταψύχηται τὸ θερμὸν τὸ κοινωνοῦν αὐτῆς. καθάπερ γὰρ εἴρηται πολλάκις, συντήκεται αὐτὸ ὑφ' αὑτοῦ). Roughly, then, the difference between Ar. and T. is that T. makes senile decay *directly* due to 'indigestion', Ar. to failure of the heart's action, which is itself caused by failure—in animals which breathe—of the lungs to do their work (op. cit. 479a 10 ὅταν οὖν τοῖς μὲν ὁ πλεύμων τοῖς δὲ τὰ βράγχια σκληρύνηται, διὰ χρόνου μῆκος ξηραινομένων τοῖς μὲν τῶν βραγχίων τοῖς δὲ τοῦ πλεύμονος, καὶ γινομένων γεηρῶν, οὐ δύνανται ταῦτα τὰ μόρια κινεῖν οὐδ' αἴρειν καὶ συνάγειν. τέλος δὲ γινομένης ἐπιτάσεως καταμαραίνεται τὸ πῦρ. Thus, if Ar. had only understood the functions of respiration better, he might have said with Huxley (*Lessons in Elementary Physiology* i, p. 20) that life has 'but two legs to stand upon, the lungs and the heart', and that the 'immediate cause of death is always the failure of one or of the other. As it is, he makes life 'stand on one leg'.

81 e 1–2. πᾶν γὰρ . . . ἡδύ. This had been already explained at length in the section on pleasure–pain, 64 a–65 b.

81 e 4. ἀπονώτατος τῶν θανάτων. Aristotle reproduces this when he says (op. cit. 479a 20) that ἄλυπός ἐστιν ὁ ἐν τῷ γήρᾳ θάνατος, because the 'release' (cf. λυθεῖσα, d 7) of the soul is so gradual as to be imperceptible, οὐδενὸς γὰρ βιαίου πάθους αὐτοῖς συμβαίνοντος τελευτῶσιν, ἀλλ' ἀναίσθητος ἡ τῆς ψυχῆς ἀπόλυσις γίνεται παντελῶς. As the phrase ἀπόλυσις τῆς ψυχῆς is out of harmony with Ar.'s own psychological presuppositions, the words are probably a direct allusion to our passage.

81 e 6—86 a 8. τὸ δὲ τῶν νόσων . . . ἀπαλλάττεται μόλις. *Physical disease.* We have now completed our account of the physiology of the healthy body and have to append to it an account of the various ways in which the physiological processes may be disordered. We must distinguish here between the general theory of the nature of disease and the special principle which T. adopts as the basis of his classification of particular disorders. The general theory goes back to the view of Alcmaeon that health depends on ἰσονομία, the 'balance of power' between the constituents of the organism; disease is due to the 'usurpation' (πλεονεξία) or, as Alcmaeon phrased it, the 'autocracy' (μοναρχία) of some constituent. The theory is worked out by a fusion of this doctrine with the Empedoclean doctrine of the 'four roots' as the components of the body. So that, when we remember the close relations between the medical school of Crotona and the Pythagorean society (see *EGPh.*[3] 193–4), we find

once more the same attempt to combine Pythagorean and Empedoclean conceptions which has met us so often already. It is this attempt to get the 'four roots' into a framework of Pythagoreanism which gives T.'s version of the theory of disease as *πλεονεξία* a different complexion from the similar theories of others and in particular from the most familiar of all, the 'humoral pathology' of the school of Cos. The particular classification of diseases adopted is determined by the same considerations. This explains why Galen who followed the Coan views, and made the appearance of the 'humoral pathology' a criterion of the genuineness of works ascribed to Hippocrates, subjects this section of the *Timaeus* to a severe criticism which we shall have to consider. So far as I can discover, neither the way in which the *πλεονεξία* doctrine is worked out nor the peculiar classification of diseases meets us outside the *Timaeus*. This does not prove that Plato invented these things for himself. I believe it will be possible to show that there are some striking coincidences between the statements of T. and even the little that has been revealed in recent years of the medical views of Philolaus by the discovery of the fragments of the *Iatrica* of the Peripatetic Meno. Probably if we only knew more we should discover that T. is reproducing the theories of Philolaus and his friends with reasonable accuracy.

For purposes of comparison, it is convenient to give here a brief summary of the Coan version of the theory of *ἰσονομίη* and *μοναρχίη*. According to this version, as it is laid down, e.g. in the *περὶ φύσιος ἀνθρώπου* (now frequently ascribed to Hippocrates' nephew Polybus, but regarded by Galen as a work by Hippocrates himself), the four constituent 'fluids' or 'humours' (*ὑγρά*) of the body are blood, phlegm, red or yellow bile (*ξανθὴ χολή*), black bile (*μέλαινα χολή*). All are constituents of the normal organism, and perfect health is the equilibration of the four; excess of any one produces disease. (*περὶ φύσιος ἀνθρώπου* (Kühn i. 352). It has just been stated that all creatures are composed of *τὸ θερμόν, τὸ ψυχρόν, τὸ ξηρόν, τὸ ὑγρόν.* The writer proceeds *τὸ δὲ σῶμα τοῦ ἀνθρώπου ἔχει ἐν ἑωυτῷ αἷμα καὶ φλέγμα καὶ χολὴν διττήν, ἤγουν ξανθήν τε καὶ μέλαιναν. καὶ ταῦτ' ἐστὶν αὐτέῳ ἡ φύσις τοῦ σώματος καὶ διὰ ταῦτα ἀλγέει καὶ ὑγιαίνει. ὑγιαίνει μὲν οὖν μάλιστα ὁκόταν μετρίως ἔχῃ ταῦτα τῆς πρὸς ἄλληλα κρήσιος καὶ δυνάμιος καὶ τοῦ πλήθεος, καὶ μάλιστα ἢν μεμιγμένα ᾖ· ἀλγέει δέ, ὁκόταν τι τουτέων ἔλασσον ἢ πλεῖον ᾖ ἢ χωρισθῇ ἐν τῷ σώματι καὶ μὴ κεκρημένον ᾖ τοῖσι ξύμπασι.*) *φλέγμα* is regarded as the cold constituent (Kühn i. 357 *αὔξεται ἐν τῷ ἀνθρώπῳ τὸ μὲν φλέγμα χειμῶνος . . . ψυχρότατόν γάρ ἐστι*). *αἷμα* is warm and moist (ib. i. 358 *ὑγρόν τε γάρ ἐστι καὶ θερμόν*). *χολή* is said to be dry and hot (ib. i. 359 *ξηρή τε γάρ ἐστι καὶ θερμή*). There is an attempt (ib. i. 360) to get a correspondence between microcosm and macrocosm by making the 'humours' answer to the different seasons of the year. The complete systematic working out of the theory demands the further distinction that the *χολή* which is 'warm and dry' is the *ξανθή*; *μέλαινα χολή* is cold and dry. This makes the composition of the four humours answer exactly to that which was adopted for the 'four roots' when they were got into the framework of older Milesian ideas by regarding them as binary combinations of the 'opposites', earth being cold and dry, water cold and moist, air hot and moist, fire hot and dry.

Through Galen the humoral pathology in this form passed right on to the medieval world. It is from the application of it to psychology that we get the familiar doctrine of the four distinct 'temperaments' or 'blends' (*κράσεις*), in each of which there is some departure from the state of ideally perfect mental health, the sanguine, phlegmatic, choleric, and melancholic. T.'s doctrine differs from this on a point of fundamental importance. His classification of diseases is not based on the enumeration of the 'humours'; indeed, he only mentions *φλέγμα* and *χολή* as secretions found in the *diseased* body, and leaves us to determine, if we can, by inference, whether they are present in health or not. His own scheme is based directly on the 'four roots'. Disease may be caused in three ways. (1) There may be too much or too little of one of the 'roots' in the body, or what there is may be in the wrong place. Again, since, as we have been told, there are numerous subvarieties of the 'roots' themselves, disease may arise from introduction into the body of a wrong variety of one of the roots. In both these cases the disorder is due to something wrong with one or more of the 'roots' themselves. (2) The disease may be due to wrong conditions in what T. calls the *δεύτεραι συστάσεις*, secondary formations, i.e. the various organic tissues, bone, flesh, fibre, &c., which are formed from the 'roots' in the ways already described. Most of what T. says refers to disorders of this kind, his theory in the end being that they can all be referred to the formation of what we should now call 'toxic' secretions which pollute the blood. (3) Finally a whole variety of disorders not referable to either of these two classes is due to accumulations of wind, phlegm, or bile in the organism. Galen's unfavourable criticism attacks (1) the attempt to take the 'roots' themselves and not the 'humours' as physiological ultimates, (2) the statements made about the aetiology of some of the particular disorders. He looks on the whole section as the work of a man of genius who was a layman in medicine.

82 a 1–b 7. ***τεττάρων γὰρ ὄντων γενῶν . . . παρέξεται.*** This section deals with the first class of disorders, those which are due to (*a*) having too much or too little of a 'root' in the body, or (*b*) having it in the wrong place, or (*c*) having it of the wrong variety. (*a*) covers the *πλεονεξία καὶ ἔνδεια*, 'excess and defect' of a 2–3, (*b*) the *τῆς χώρας μετάστασις ἐξ οἰκείας ἐπ' ἀλλοτρίαν γιγνομένη* of a 3–4, (*c*) the *τὸ μὴ προσῆκον ἕκαστον ἑαυτῷ προσλαμβάνειν* of a 5–6.

82 a 2. ***πλεονεξία***, here literally perhaps, 'the having too much', with *τούτων* as *objective* genitive. But I think it more likely that *τούτων* is subjective gen. and that *πλεονεξία* means 'vaulting ambition', 'usurpation'. Cf. Hippocr. *περὶ ἀδένων* (Kühn i. 494) *ἐν τοῖσι τέλμασι τῆς γῆς καὶ καθύγροισιν οὐ φύεται τὸ σπέρμα οὔτ' ἐθέλει ἀναβαίνειν τῆς γῆς ἄνω, ἀλλ' ἀποσήπεται καὶ ἀποπνίγεται τῇ πλεονεξίῃ. βιῆται γὰρ τὸ σπέρμα, βιῆται δὲ καὶ ἐν τοῖσιν ἐντέροισιν ἡ πληθὺς καὶ τὸ ὑγρὸν πουλὺ καὶ οὐκ ἂν φύσαι τρίχας.* The second *βιῆται* here being plainly transitive, the first is presumably transitive too, and *σπέρμα* is accus. The sense is that 'in marshy places seeds will not come up if sown, because the moisture does violence to the seed'. Hence the meaning of the words *ἀλλ' ἀποσήπεται . . . πλεονεξίῃ* must be that the seeds are choked 'by the encroachment' (of

the water). So op. cit. i. 497 *ἐπεὶ μᾶλλον πλεονεκτεῖν ἐθέλουσα* (sc. *ἀδὴν*) *οὐδεμίη τότε πλῆθος ἔχειν δύναται ἀλλ' . . . ἰσότης ἐστὶν αὐτέῃσιν.* The metaphor is kept up in the next words *τῆς χώρας μετάστασις.* The matter which has got into the wrong place is thought of as an invader unlawfully intruding on some one else's territory.

82 a 4–7. πυρός τε αὖ . . . παρέχει. Martin and A.-H. are clearly right in making the genitives *πυρός, τῶν ἑτέρων* depend on *γένη* and removing the comma placed by some editors (Bekker, St., Turr.) after *ἑτέρων*, as we are now passing from case (*b*) to (*c*). 'And, furthermore, (*αὖ*) since there are several varieties of fire and the like', *τὸ μὴ προσῆκον . . . προσλαμβάνειν*, 'the reception (by the body) of an inappropriate variety of one of them' (*ἕκαστον* object-accusative, the subject is understood) and *πάνθ' ὅσα τοιαῦτα* are the subjects of *παρέχει.* The common use of *στάσις* for a condition of bodily 'disorder' is due to the same metaphor as Alcmaeon's formula about *ἰσονομίη.* Disorder is 'faction' in the commonwealth of the body, just as civil turmoil is *νόσος* in the body politic.

82 b 1–2. καὶ κοῦφα δὴ καὶ βαρέα. Not 'the light becomes heavy' (A.-H.), a rendering which disregards the second *καί.* Both *κοῦφα* and *βαρέα* are predicative, the subjects being supplied from the context. 'And (the constituents of the body) become light and heavy', i. e. those which in health are heavy become light, and vice versa. So 'the constituents' are the understood subject to *δέχεται* in b 2.

82 b 5. πλημμελήσῃ. This common use of the word arises from the Pythagorean association of medicine with music (on the ground that both have to do with the maintenance of a *κρᾶσις* or 'temperament'). The ethical use of *πλημμελεῖν* has the same origin. Tr. 'a false note struck by the withdrawal or accession of anything contrary to these conditions, gives rise to . . .'

82 b 5–6. τούτων ἐκτός. *τούτων* depends, I take it, on *ἐκτός*, not on *τι.* For the order *τούτων ἐκτός* (not the usual one in Plato), cf. *Rep.* vi. 498 b 8 *ὅταν δὲ λήγῃ μὲν ἡ ῥώμη, πολιτικῶν δὲ καὶ στρατειῶν ἐκτὸς γίγνηται, Tim.* 29 e 2 *τούτου δ' ἐκτὸς ὤν.* So rightly M.

82 b 8. δευτέρων . . . συνεστηκυιῶν. The clause is a genitive absolute, as is indicated by Bt.'s punctuation, not a genitive after *νόσων*, as is implied by the punctuation of Bekker, St., M., A.-H., and others. 'Once more, since secondary formations exist, there is a second class of disorders to be discussed by any one who will look for them.' This brings us to the second of T.'s three classes of diseases. The remark is added that most disorders belong to the first class, being due to the excess or defect of some 'root' or the occurrence of an inappropriate variety of a root, but the most serious owe their gravity to the inversion of the natural order of the formation of tissue. (From the examples of *δεύτεραι συστάσεις*, marrow, bone, flesh, sinew, we see that they correspond exactly with what Aristotle calls the *ὁμοιομερῆ*, as distinct from the *ὀργανικὰ μέρη* of the body, the parts which are subdivisible into parts similar to themselves. The parts of blood, flesh, &c., are themselves smaller volumes of blood, flesh, &c.; the parts of a heart, a hand, an eye are not lesser hearts or hands or eyes. Thus we may render the distinction by contrasting

'tissues' with 'organs'.) The nature of the inversion is entered on at 82 c 7 *κατὰ φύσιν γὰρ κτλ.* The thought is that if in the natural order of things *C* is a product of *A* and *B*, then a decomposition of *C* may lead to morbid changes in *A* and *B*, and that is how the worst diseases originate. The natural order of development has been described already. Flesh and sinew (*νεῦρα*) are formed from the blood, sinew from the fibres in it (*ἶνες*), flesh by a coagulation of what has been left when blood has been defibrinated. Sinews and flesh, in turn, produce a sticky, oily substance (*γλίσχρον καὶ λιπαρόν*) which cements (*κολλᾷ*) the flesh to the bones and also feeds the vertebral column; indeed, the finest part of it actually percolates through this column and 'waters' (*ἄρδει*) the spinal cord itself. T. does not seem to know that the defibrinated blood does not congeal, as Aristotle correctly states in the passage referred to by M. and A.-H. (*Hist. Animal.* Γ. 515^b 30 *ἔστι δὲ καὶ ἄλλο γένος ἰνῶν, ὃ γίνεται μὲν ἐν αἵματι, οὐκ ἐν ἅπαντος δὲ ζῴου αἵματι· ὧν ἐξαιρουμένων ἐκ τοῦ αἵματος οὐ πήγνυται τὸ αἷμα, ἐὰν δὲ μὴ ἐξαιρεθῶσι, πήγνυται*). Yet, oddly enough, T. himself states the actual facts quite correctly at 85 d 2–5, apparently without perceiving that he is contradicting himself. See n. on that passage. T.'s account of the supposed fluid which joins the flesh to the bones and irrigates the spinal cord is also quite fanciful. Apparently the thought is that the periosteum, the membrane round a bone, is formed by the coagulation of this fluid (see M. ii. 350, n. 178 'What really attaches the flesh to the bones is the tendons, ligaments, and aponeuroses'.)

The theory of the cause of the *μέγιστα νοσήματα* is, then, that when the *δεύτεραι συστάσεις* are formed in the order just described, we have health, but when the order is reversed, as e. g. when the quality of the blood is affected by action of the flesh on it, you get a grave disease. If anything sets up decomposition in the flesh and the diseased flesh in turn infects the blood, it gives the blood a saline character, and this leads to the formation of various kinds of bile, phlegm, and serum. Thus the *μέγιστα νοσήματα* are all caused by blood-poisoning of some kind.

82 c 8. ***νεῦρον μὲν ἐξ ἰνῶν.*** 'That is, from the fibrine of the blood, which both Plato and Aristotle distinguished from the serum, *ἰχώρ*, though the globules were unknown to them' (A.-H.). Yet if the text of 84 a 1 is not hopelessly corrupt, the *ἶνες* there referred to must mean, as A.-H. adds, 'the fibrine of the flesh, not of the blood'. Presumably Plato did not make any clear distinction between the two.

82 d 1. ***ὃ πήγνυται χωριζομένων ἰνῶν.*** Apart from the error about the coagulation of defibrinated blood, this statement raises a further question. Is it consistent with what we were told about the composition of *σάρξ* at 74 c–d? *αἷμα*, as we have learned, is just the *τροφή* cut up small and heated by the action of the internal 'fire'. Thus it will contain all the different 'roots'. Flesh, according to 74 c, is a composition of *μυελός*, which already contains all four 'roots' + earth + fire + water, and *νεῦρα* are 'bone + unfermented flesh'. But here flesh is said to be produced from *αἷμα* by the subtraction of whatever it is that makes the fibrine, and *νεῦρα* are formed from the fibrine. The two accounts do not seem easily reconcilable, and I suspect that Plato has taken the details of his

physiology from more than one medical work, and that his sources did not wholly agree with one another. So far, Galen's description of this part of the dialogue as the work of an intelligent 'layman' seems justifiable.

82 d 3. κολλῷ. Special prominence is given to τὸ κολλῶδες (the 'viscous') as a constituent of the body in the Hippocratean περὶ σαρκῶν (or ἀρχῶν), with which we have already found several points of contact in T.'s physiology. There we are told (Kühn i. 427) that the brain is the 'centre' of the 'cold and viscous' in the body, μητρόπολις τοῦ ψυχροῦ καὶ τοῦ κολλώδεος. But this author distinguishes, as T. seems not to do, between κολλῶδες and λιπαρόν, for he adds τὸ δὲ θερμὸν τοῦ λιπαροῦ μητρόπολις; i. 428, he denies the continuity of the substance of the brain with the μυελός, on the ground that the latter does not contain much of the κολλῶδες. It is worth noting that (i. 431) he specially insists that ἶνες are ψυχραὶ καὶ κολλώδεες. The tract itself, however, seems to be a jumble of not quite consistent theories, since, in spite of the alleged connexion of κολλῶδες with ψυχρόν and of λιπαρόν with θερμόν, κολλῶδες and λιπαρόν are more than once combined, as when we are told that (Kühn i. 431) τὸ θερμὸν καὶ κολλῶδες is the chief ingredient in the spleen, which only contains enough of the ψυχρόν to solidify (πῆξαι) τὸ κολλῶδες αὐτὸ ὅ εἰσιν αἱ (add ἶνες) ἐνοῦσαι ἐν τῷ σπληνί.

82 e 4. μετὰ πνεύματος. M. takes this to prove that T. regards the blood-vessels as normally containing air as well as blood. Probably something of the kind is implied in the account of respiration. But I do not think this passage can fairly be cited to prove the point. The πνεῦμα seems to me to be here 'pathological', like the other formations mentioned immediately below. See next note.

82 e 6–7. χολὰς καὶ ἰχῶρας καὶ φλέγματα παντοῖα. This looks as though T. regarded bile and phlegm (two of the four normal constituents of the body, according to the 'humoral' physiology), as morbid secretions which are not present in health. M. appeals to 71 b—the account of the dreams produced by the action of χολή on the liver—as proof that bile is meant to be a normal ingredient, but the passage seems to me to prove nothing. Bile is only mentioned there in connexion with terrifying dreams due to the state of the liver, and we may surely add, to a disordered state of the liver. It is worth noting that we learn from the papyrus fragment of the *Iatrica* of Menon (*Fr. d. Vors.*[3] i. 308) that Philolaus agreed with the early Pythagorean Petron of Himera in holding that man has no χολή at all, or that if he has, it is superfluous (καὶ σχεδὸν οὗτος—Petron—ὡς ὁ Φιλόλαος οἴεται μὴ εἶναι ἐν ἡμῖν χολὴν ἢ ἄχρειον). Philolaus further regarded the bile, the blood, and the phlegm as the source of all diseases, according to the same authority (op. cit. i. 308 λέγει δὲ γίνεσθαι τὰς νόσους διά τε χολὴν καὶ αἷμα καὶ φλέγμα, ἀρχὴν δὲ γίνεσθαι τῶν νόσων ταῦτα). Thus the medical theory of Philolaus departed widely from the 'humoral' pathology. T.'s account propably owes a good deal to these views of his Pythagorean contemporary Philolaus. On the whole, I think the absence of any definite reference to φλέγμα and χολή in the healthy organism means that T. regards both as morbid secretions. The language of Menon (loc. cit.) suggests that Philolaus held this view

about χολή, which he called ἰχὼρ τῆς σαρκός. Since he denied that χολή has any function in the human organism, it looks as if he meant that it is a distillation from diseased flesh. Timaeus seems to be reproducing him here, when he couples χολάς and ἰχῶρας and speaks of their arising from the toxic effects of τηκομένη σάρξ on the blood in the blood-vessels. Aristotle regarded χολή in man as a mere superfluous product without any function, a περίττωμα. His reason was that it was his theory that the gall-bladder is not universally found in all members of the species, *de partibus Animal.* Δ. 676b 31 ἔνιοι μὲν γὰρ φαίνονται ἔχοντες χολὴν ἐπὶ τοῦ ἥπατος, ἔνιοι δ' οὐκ ἔχοντες. διὸ καὶ γίνεται ἀμφισβήτησις περὶ ὅλου τοῦ γένους. That is, some authorities would hold that the cases of its absence are mere 'sports' and would put the possession of a gall-bladder down among the specific characters of *homo sapiens*, others would not. His own view is given at 677a 12 ἔοικεν ἡ χολή (the gall-bladder), καθάπερ καὶ ἡ κατὰ τὸ ἄλλο σῶμα γινομένη ('bile' in general) περίττωμά τι ἐστιν ἢ σύντηξις, οὕτω καὶ ἡ ἐπὶ τῷ ἥπατι χολὴ περίττωμα εἶναι καὶ οὐχ ἕνεκά τινος, ὥσπερ καὶ ἡ ἐν τῇ κοιλίᾳ καὶ ἐν τοῖς ἐντέροις ὑπόστασις (sediment). It will be seen that though Ar. does not apparently regard χολή as a morbid secretion, he agrees with Petron aud Philolaus in holding that it is a mere by-product or waste product in the human organism. The use of the word σύντηξις looks like a reminiscence either of Timaeus or of his source. The author of *Timaeus Locrus* (102 b–c) certainly took Plato to mean that φλέγμα and χολή are *morbid* secretions.

83 a 2. τάξιν . . . περιόδων. That is, the morbid secretions circulate irregularly. Disturbance of the patient's pulse is a symptom of these disorders.

83 a 4. τῷ συνεστῶτι δὲ τοῦ σώματος καὶ μένοντι κατὰ χώραν. The metaphor is once more political, 'the elements of the body which are regularly established and stick at their post'. The still sound are compared with the legitimate forces of the state, the unsound with conspirators in arms aiming at the establishment of a τυραννίς. So the expression used of the boy who is not fit for military service by Aeschylus, *Agam.* 78 Ἄρης δ' οὐκ ἔνι χώρᾳ, pretty clearly means 'Ares is not *at his post*' in the boyish frame.

83 a 5–b 8. ὅσον μὲν οὖν . . . πυρός. The object of the clauses is to get in both the kinds of χολή as produced by τηκεδὼν τῆς σαρκός. The difference in colour, and the superior malignity of the disorders due to the collection of μέλαινα χολή are both accounted for by the view that the black bile originates in the corruption of older and harder flesh. The wording of the passage seems to me plainly to indicate that T. regards both μέλαινα and ξανθὴ χολή as morbid secretions. T. distinguishes three colours of χολή (*a*) the black, arising from the completest corruption and corrosion of the oldest flesh; this is specially deadly (χαλεπόν) to any part of the body to which it may find its way, and in taste is πικρόν, though sometimes the πικρότης is less marked and the taste is merely ὀξύ; (*b*) the greenish, which is due to a dilution of 'black bile' with blood; (*c*) the yellow (ξανθόν), which is also πικρόν, but is produced by the corruption of more recently formed and tenderer flesh.

83 a 7. παλαιᾶς, 'long-standing', the universal reading of the MSS.

is above suspicion here. But is Bt. right in ascribing the facile variant πολλῆς to Cornarius? Müller records παλαιᾶς as restored, against the πολλῆς of MSS., by Cornarius in the quotation of the passage in Galen's *de Hipp. et Plat. placitis.*

83 b 6. χλοῶδες is only weakly supported against χολῶδες (A F W Y) in MSS. but was read by Galen and is obviously correct; you could not call one of several colours assumed by bile the 'bilious' colour. And, as M. reminds us, at 68 c 7 green has been explained as a combination of red and black, so that the statement that the colour of 'black bile' diluted (βαφεῖσα) with blood is greenish is in keeping with T.'s general colour-theory.

83 b 7–8. ὑπὸ τοῦ . . . πυρός. The phrase is a little singular; as φλόξ has been described (58 c 6) as one of the varieties of πῦρ; 'the fire of the flame' would, in English, represent the same singular combination of words. But the genuineness of the words seems sufficiently guaranteed. One can only suppose that what is meant is 'the fire which emits the flame' (φλόξ, it will be remembered, itself οὐ καίει). This 'fire' must be supposed to reside in the corroded flesh which is the source of the whole trouble. It has already been said to be 'burnt' (ὑπὸ παλαιᾶς συγκαύσεως, a 7), and 'fire' is the only body which can 'burn'. Thus the meaning is 'the inflammation' in the diseased flesh. Or to be strictly accurate, the inflammation is the πῦρ, the φλόξ connected with it will be the colour of the resulting product, since we have already learned that colours are φλόγες (67 c 6).

83 b 8–c 3. καὶ τὸ μὲν κοινὸν . . . πᾶσιν. That is, Timaeus doubts, or affects to doubt, whether a mere ἰατρός (they were reckoned among δημιουργοί), can have had sufficient acumen in 'discerning the one in the many and the many in the one' to recognize that such apparently different bodies as the black, greenish, and reddish χολαί all constitute varieties of one and the same γένος and to define that γένος. He means that the originator of the classification of χολαί must have been more than a 'specialist', he must have been a 'philosopher'. No doubt he ascribes the whole thing to a Pythagorean φιλόσοφος interested in medicine. Note that he does not use the technical word of Socrates and Plato themselves, διαλεκτικός, though that is precisely what he means. 'Dialectic', in fact, arose not among the Pythagoreans, but, as Aristotle said, from the antitheses of Zeno. Contrast such passages as *Phaedrus* 266 c 7 τοῦτο μὲν τὸ εἶδος (sc. the method of the man who is δυνατὸς εἰς ἓν καὶ ἐπὶ πολλὰ ὁρᾶν) ὀρθῶς ἔμοιγε δοκεῖς καλεῖν, διαλεκτικὸν καλῶν, *Rep.* vii. 537 c 7 ὁ μὲν γὰρ συνοπτικὸς διαλεκτικός, ὁ δὲ μὴ οὔ. For a lively description of the difference between the physician who is a genuine man of science and the mere empiric see *Laws* iv. 720 a 6–e 5.

83 c 3–4. τὰ δ' ἄλλα . . . ἴδιον. Thus T. does not assume that there are just two kinds of χολή, the μέλαινα and the ἐρυθρά. He holds that there are a considerable number, which it is not necessary to specify, each with its peculiar colour. This, again, hardly fits in with the view that χολή is a normal and valuable secretion, but if it is regarded as morbid, we can quite understand why many of its varieties are passed over.

83 c 5–7. ἰχὼρ δὲ . . τὸ τοιοῦτον. We pass now to another secretion

which causes disease, φλέγμα, of which T. again mentions more kinds than one. Grammatically ἰχώρ and the subdivisions, ὁ μὲν αἵματος, ὁ δὲ μελαίνης χολῆς are in whole-and-part apposition, πρᾷος and ἄγριος are predicative, as the position of the articles shows. Tr. 'And as to serum, that of blood is a gentle lymph but that of black and acid bile, when rendered saline by heat, is a virulent lymph, and is known as acid phlegm'. The use of the word ἰχώρ here recalls the statement of Menon's *Iatrica* that Philolaus regarded χολή as ἰχὼρ τῆς σαρκός. There seem to be points of contact with Philolaus also in the account of φλέγμα. The generally accepted view was that φλέγμα is the 'cold' fluid among those in the body. Philolaus insisted that it is hot, and denied that there is any 'cold' constituent in the human body, on the ground that the γονή is 'hot', the womb which receives it is 'hot', and therefore what comes from such sources must itself be hot. In fact, it is just to cool this original heat that animals begin to breathe when they are born (*Fr. d. Vors.*[3] i. 308 Φ. ὁ Κροτωνιάτης συνεστάναι φησὶν τὰ ἡμέτερα σώματα ἐκ θερμοῦ. ἀμέτοχα γὰρ αὐτὰ εἶναι ψυχροῦ, ὑπομιμνήσκων ἀπό τινων τοιούτων· τὸ σπέρμα εἶναι θερμόν, κατασκευαστικὸν δὲ τοῦτο τοῦ ζῴου· καὶ ὁ τόπος δέ, εἰς ὃν ἡ καταβολή (μήτρα δὲ αὕτη), ἐστὶν θερμότερα καὶ ἐοικυῖα ἐκείνῳ· τὸ δὲ ἐοικός τινι ταὐτὸ δύναται ᾧ ἔοικεν· . . . τό τ' αὖ φλέγμα τῶν πλείστων ψυχρὸν εἶναι λεγόντων, αὐτὸς θερμὸν τῇ φύσει ὑποτίθεται. For the very name φλέγμα is derived from φλέγειν (ἀπὸ γὰρ τοῦ φλέγειν φλέγμα εἰρῆσθαι), and 'inflammations' are caused by φλέγμα (ταύτῃ δὲ καὶ τὰ φλεγμαίνοντα μετοχῇ τοῦ φλέγματος φλεγμαίνει). Since Timaeus says at 83 d 7 that ἱδρώς and δάκρυον (both of which have already been declared to have 'fire' in them) are the 'lymph' (ὀρός) of φλέγμα and never alludes to the view that this humour is cold, he probably is taking Philolaus's view of it, though he does not accept the theory that 'inflammations' are caused by it. As φλέγμα is only mentioned in connexion with disease, and is supposed to be one of the products of σύντηξις, it would seem that T. regards it as a purely morbid secretion, not as a normal constituent of the body. Whether Philolaus also held this view we have not the means of deciding. But the extract from Menon, with its curious statement τὸ δὲ φλέγμα συνίστασθαι ἀπὸ τῶν ὄμβρων φησίν, looks as though he did. T. specifies two varieties of φλέγμα (*a*) the *acid* (ὀξύ) which is the lymph of μέλαινα χολή, (*b*) the *white* which is a τηκεδὼν ἁπαλῆς σαρκός mingled with air and consequently frothy. Sweat, tears, and all similar exudations are the ὀρός or lymph of the white phlegm. Apparently it is only these exudations, as distinct from the completely formed φλέγμα, that he regards as present in the normally healthy body. The view that φλέγμα is 'hot', it may be noted, is expressly asserted in one work of the extant 'Hippocratic' corpus, περὶ νόσων δ̄, where it is said (Kühn ii. 358) that fevers may be caused by a superfluity of αἷμα, φλέγμα, or χολή, θερμότατα γὰρ ταῦτά ἐστιν. In the sentence τὸ δ' αὖ . . . φαμέν (83 c 7–d 6), we have once more an example of a common type of 'anacoluthon'. The sentence opens as if τὸ μετ' ἀέρος τηκόμενον were to be the subject-accusative to the εἶναι dependent on φαμέν. Owing to the distance of this subject from the infinitive, it is resumed in d 5 by ταύτην πᾶσαν τηκεδόνα, so that the τὸ τηκόμενον at first sight seems to be 'outside the

construction'. There is a further anacoluthon within the anacoluthon which is correctly explained by Fraccaroli. With τὸ . . . τηκόμενον we must not supply φλέγμα; τὸ μετὰ ἀέρος τηκόμενον is itself a quasi-substantive. The τούτου of the following genitive absolute clause must then refer to this same formation, the construction being slightly changed. So the sense is finally, 'But as for what results from the liquefaction of fresh and tender flesh and the action of air (the said substances being swollen with wind and surrounded by moisture) . . . we call all this liquefaction of tender flesh combined with wind white phlegm'.

83 e 1. σώματα . . . καθαιρόμενα. The true reading has to be gathered from comparison of the texts of F W Y A. A.'s σῶμα . . . καθαιρόμενα will not construe. As between F and W Y the advantage seems to lie on the side of F, and the reading of W Y would be certain to arise at once if the τα of σώματα were lost before the following τό.[1] It is less likely that if σῶμα . . . καθαιρόμενον had been the earlier text τα could have intruded itself. Tr. 'and all such other bodies as are daily exuded as purgations'. With Y's reading ὅσα τε ἄλλα τοιαῦτα must be taken as 'internal accusative' with χεῖται, 'and all else into which the body is liquified daily as it is purged'.

83 e 4–5. παρὰ τοὺς τῆς φύσεως . . . νόμους. One of the earliest occurrences of the phrase in literature. νόμους means, however, rather 'use and wont', 'regular custom' than what *we* understand by a 'law of nature'. We commonly mean by the phrase a universal proposition about the course of nature to which there are no exceptions, and consequently the formation of morbid secretions is just as much an illustration of 'law in nature', in our sense of the word, as the formation of healthy secretions. T. regards the former as 'contrary to' the νόμοι τῆς φύσεως, by which he means the 'normal' order of things in the healthy body. So when Callicles says in the *Gorgias* (483 e 3) that the strong act κατὰ νόμον γε τὸν τῆς φύσεως in using the full advantage of their strength, he does not mean what a modern writer would by saying that they are acting 'in accord with a law of nature'. His point is not that this is how the strong invariably do act, but that they are blameless if they behave in this way, because they are following 'the use and wont of reality' as contrasted with the, often unreasonable, 'use and wont' of human civil life. The phrase 'Nature's νόμος' is meant to have a certain paradoxical ring, since it was the custom in the Periclean age to oppose νόμος, 'custom', 'tradition', 'convention', sharply, as a thing of purely human invention, to φύσις, 'the real', 'things-as-they-are'.

83 e 5–7. διακρινομένης . . . δύναμις. Sc. the mischief is only half as grave ⟨as it might be⟩, if the flesh alone is diseased but its 'foundations' remain sound, since in such a case recovery is not so very difficult. The αὐταῖς of e 6 clearly means ταῖς σαρξὶν ἑκάσταις, 'flesh in the various regions of the body', 'the various fleshy parts'. The πυθμένες must be those of the flesh. It is clear that these πυθμένες do not mean the primary corpuscles of the four kinds, nor yet their constituent triangles, since we are dealing throughout the section 82 b 8—84 c 7 with the disorders of the δεύτεραι

[1] Rivaud, disagreeing with Bt., gives this as also the reading of A[1], and ascribes the καθαιρόμενα to the 'corrector'.

συστάσεις. The πυθμένες of the flesh, therefore, must mean the tissues which Timaeus goes on to mention, 'that which binds flesh to bone' and the rest. They are called πυθμένες of the flesh in accord with the statement of 82 c 7 ff., and also, I suppose, because they lie underneath and support the outermost layers, flesh and its coverings of skin.

84 a 1–3. καὶ μηκέτι αὐτὸ ἐξ ἰνῶν αἷμα . . . δεσμός. There seems to be a prearchetypal error here. αὐτό (F) is pretty clearly right as opposed to the αὖ τό of A W, since 'that which is separated out from fibre and sinews' is clearly the same thing as the supposed liquid which 'binds flesh to bone' and 'feeds' the vertebral column (cf. 82 d 2). Sufficiently grave disease of the σάρκες will infect this secretion. Hence the substance spoken of is identical with the just-mentioned τὸ σάρκας ὀστοῖς συνδοῦν, and αὖ could have no meaning in this connexion. It is to A.-H.'s credit that, knowing nothing of F, he saw that αὐτό is a necessary correction of the αὖ τό of A and earlier editors. αἷμα makes no sense, since αἷμα is neither secreted from ἶνες and νεῦρα nor is it that which 'binds flesh to bone'. The correction ἄμα (apparently made independently by Lindau and St.), gives a possible sense, 'and no longer being secreted from fibre and sinew feeds bone and fastens flesh to bone'. But it seems hardly likely that so common a word as ἄμα should have been corrupted. And I should doubt whether the corruption is confined to αἷμα. The preceding ἰνῶν appears to me equally suspicious. If the word is sound, it must mean the fibrine of the flesh, not that of the blood, as M. observes. But hitherto ἶνες have stood for the fibrine of blood (see 82 c 8). And at 82 d 2 it is the *flesh*, not ἶνες, which is mentioned along with νεῦρα as secreting this fluid. Hence it may be doubted whether the true text is now recoverable. Presumably it was on these grounds that St. did not change αἷμα to ἄμα in the text. In his note he proposes to combine this with the further change of ἰνῶν to σαρκῶν, which brings the words into accord with 82 d 2. But it is hardly likely that he thought ἰνῶν to be actually a corruption of σαρκῶν. He probably meant to indicate what he felt must be Plato's meaning without claiming to have restored his words. It seems possible that W Y's ἐκείνων is correct, and that we should read καὶ μηκέτι αὐτὸ ἐξ ἐκείνων (sc. τῶν σαρκῶν) ἄμα κτλ. If ΕΞΕΚΕΙΝΩΝ were corrupted to ΕΞΙΝΩΝ, the supposed reference to ἶνες *might* account for a mistaken alteration of ἄμα to αἷμα. Or we might read ἐκείνων ἄμα without ἐξ? The precise sense would be, with the suggested reading, that when the supposed secretion *itself* is τραχύ and ἀλμυρόν it 'for its own part' (αὐτό, a 6) separates from the bone, and the flesh too consequently 'leaves the νεῦρα exposed'.

84 a 5–b 3. τότε ταῦτα πάσχον . . . πλείω ποιοῦσιν. The effect of the corruption of the supposed fluid is threefold. (*a*) It 'crumbles away' (καταψήχεται) under the flesh and sinews and separates from the bone which it surrounds (this shows that T. is thinking of the membrane known as the periosteum, which he regards as a coagulation of the imaginary fluid); (*b*) the flesh also separates from the sinews and tendons, which in their turn are infected by the ἅλμη present in the diseased fluid; (*c*) the diseased flesh is conveyed into the blood circulating in the blood-vessels and poisons it.

84 a 7–b 1. ἐκ τῶν ῥιζῶν. The ῥίζαι of the flesh clearly mean the attachments of the flesh to the νεῦρα. See n. on 81 c 6.

84 b 4–c 3. χαλεπῶν δὲ . . . ἀπεργάζηται. So far we have dealt with diseases which originate in the δευτέρα σύστασις which is most superficial, the flesh. Still more serious are the consequences of a wrong state of things in a more deep-seated δευτέρα σύστασις, bone. It is T.'s view that the flesh is only there to prevent the bones under it from injury (74 b–c) which explains the expression τὰ πρὸ τούτων, 84 b 5. The bones are *before* the flesh in three senses; they are the more important, the kernel to the husk or rind; they 'come first', as we proceed from within, from the ψυχή to its successive 'coats'; they are, in the order of the story, devised by God or the gods earlier than what covers them.

84 b 5–6. ὅταν ὀστοῦν . . . ἱκανήν. Trouble originating in the bone itself arises when the bone is over-heated because its covering of flesh is not sufficiently porous, and hence the bone is permanently kept at an improperly high temperature. This is in keeping with 74 c, where the necessity of keeping the skeleton permanently neither too hot nor too cold was dwelt on. ἀναπνοή in this connexion means, as at 85 a 3 ἔξω δὲ τοῦ σώματος ἀναπνοὰς ἴσχον, b 7 λαμβάνουσα μὲν οὖν ἀναπνοὴν ἔξω, and probably at 91 b 2 λαβὼν ἀναπνοήν (see n. ad loc.), a 'breathing-hole' or 'vent' for air, water, or the like to get in or out at. The thought is that owing to the insufficient porousness of the flesh, the air cannot get at the bone to cool it; it is always over-heated, and this sets up caries (σφακελισμός).

84 b 6–c 3. ὑπ' εὐρῶτος . . . ἀπεργάζηται. The stages, then, are these. (*a*) the over-heated bone begins to decay; (*b*) the decaying matter, as it crumbles, passes into and infects the τροφή of the bone, i. e. the supposed fluid from which the periosteum is derived; (*c*) this leads to the further poisoning of the flesh, and this (*d*) to blood-poisoning with symptoms even severer than those found where the trouble originated in the flesh.

84 c 3–7. τὸ δ' ἔσχατον πάντων . . . ῥυείσης. There is still a third variety of disease due to the abnormal generation of toxic substances which corrupt the blood, and it is the most serious of all. This is when the trouble is originated even further back than in the second case, taking its rise in the μυελός, the most central and important of all the structures in the organism. In this case *all* the processes of secretion are 'inverted'; there is no 'sound core' left in the body at all, and that is why these disorders are the most infallibly mortal (κυριώτατα πρὸς θάνατον), their prognosis the least favourable of all. All the cases so far considered belong to the second general class of disorders recognized by T., disorders of the δεύτεραι συστάσεις. The general account of the whole class is that they are due to the formation of toxic secretions (of which φλέγμα and χολή are given as examples) in the blood. They differ in gravity according as the tissue in which the process leading to the poisoning of the blood is more or less deep-seated; it may be flesh, or again bone, or finally μυελός. In all cases the general character of the malady is the same, but the deeper its seat, the more aggravated it is, and the less hope there is of a recovery. It should be obvious that we are dealing with a serious and comprehensive theory of the aetiology of disorders. It is hardly conceivable that Plato, who was, as Galen rightly insists, an ἰδιώτης, though an intelligent one, in medical matters, should have been at the pains to elaborate

such a detailed theory for himself merely to fill two or three pages of T.'s discourse. The whole passage smells of the medical text-book. So far as an ἰδιώτης like myself can discover, there is no trace of this peculiar theory of the causes of disease in the very miscellaneous collection which has been handed down to us as the 'works of Hippocrates'. But it is significant that the three sources of disease recognized by Philolaus, according to the *Iatrica* of Menon, were φλέγμα, χολή, αἷμα. Since the three sub-classes of grave maladies which have just been discussed are all cases of the poisoning of the blood, and the discussion has been preceded by a description of χολή and φλέγμα, we may probably conclude with reasonable probability that in all Timaeus has to say about disease arising in the δεύτεραι συστάσεις he is following the authority of Philolaus, as would be natural, since Philolaus, like himself, was concerned to bring biology, for which Empedocles was the great source in Sicily and Magna Graecia, into union with Pythagoreanism.[1]

84 c 8—86 a 8. τρίτον δ' αὖ . . . ἀπαλλάττεται μόλις. We now come to a third class of maladies caused by accumulations of πνεῦμα (wind), by φλέγμα and by χολή. M.'s note 185 gives a good conspectus of T.'s whole classification. The disorders of the first class are 'vices of temperament', and include, besides minor ailments, the four kinds of fevers shortly to be noticed. The second class are consumptions and diseases of the bones and marrow. The third class, to which we are now proceeding, are pulmonary disorders, pleurisies, and tetanus (all caused by πνεῦμα), epilepsy (due to phlegm and black bile), dysenteries and internal inflammatory disorders (due to bile), eczemas and kindred skin diseases and catarrhs (due to phlegm). There is a certain difficulty about the adjustment of the second and third classes. Since the general account of the formation of φλέγμα and χολή was given in the section dealing with disorders of the δεύτεραι συστάσεις, we should expect that maladies caused by phlegm and bile would be placed in that class. But in actual fact, all the examples given there seem to be of diseases regarded as due to the poisoning of the blood, and the troubles caused by φλέγμα and χολή are placed with those due to πνεῦμα in the third class. This is, at best, an awkward arrangement, and it is not a complete justification of it to say that the account of bile and phlegm was placed where it stands simply to illustrate the general process of the formation of morbid secretions. May one be allowed to suspect that in dealing with this third class, Plato is changing his medical authority, that he has combined Philolaus (or Philistion?) who treated αἷμα, φλέγμα, χολή as the three sources of all disease, with some one else who had three ἀρχαί, πνεῦμα, φλέγμα, χολή? This would account

[1] According to Plutarch (*Quaest. Conviv.* vii. 1. 699 c) the physician Philistion of Locri advocated the mistaken theory that liquid can get into the lungs by the gullet, as his townsman Timaeus is made to do. Philistion was a personal friend of Plato and one of the *entourage* of Dionysius II, as we see from *Ep.* ii. 314 d, where Plato writes that Speusippus would be glad to avail himself of his services if Dionysius can spare him, and that Philistion himself strongly wishes to visit Athens. This incidental allusion shows that Plato had excellent means of being informed about the probable doctrines of Locrian medical men. To my own mind the most likely view is that men like Philistion are responsible for all the main points in the medical part of the dialogue, and that they naturally enough followed the lead of Philolaus.

for the oddity of arrangement just mentioned; it would also explain why, though T. seems at 83 d 7 to accept Ph.'s view that φλέγμα is 'hot', at at 85 b 5 he rejects Ph.'s further view that 'inflammations' are due to φλέγμα. His second authority may have held the more common view that φλέγμα is ψυχρόν. It is perhaps worth noting that it is only in dealing with this third class of diseases that the names of the various maladies and some definite remarks about their course or their treatment are given. This also looks as though two sources, with rather different styles, had been utilized. The first source, which I take to be Philolaus, seems to have been a work of a rather speculative and general character on the aetiology of disease, the sort of thing represented in the Hippocratean corpus by e.g. περὶ φύσιος ἀνθρώπου, περὶ σαρκῶν (or ἀρχῶν), the second some work or works of a more purely observational kind, or at least, like the περὶ φυσῶν, combining speculation with a great deal of detail.

84 d 1–2. πνεύματος . . . φλέγματος . . . χολῆς. πνεῦμα, as a source of disorders, gets the fullest recognition in the 'Hippocratean' περὶ φυσῶν. The author holds that every disease whatsoever is due to one single cause, φῦσα, 'wind' in some part of the body (Kühn i. 571) ἐστὶ δὲ μία τῶν νουσέων ἁπασῶν καὶ ἰδέη καὶ αἰτίη ἡ αὐτή. For, he says, there are just three τροφαί taken into the organism, σῖτα, ποτά, πνεύματα. πνεύματα δὲ τὰ μὲν ἐν τοῖσι σώμασι φῦσαι καλέονται, τὰ δὲ ἔξω τῶν σωμάτων ἀήρ. οὗτος δὲ μέγιστός ἐστιν ἐν ἅπασι τῶν σωμάτων δυνάστης . . . (in fact, the writer holds the general cosmological views of Anaximenes, revived in the Periclean age by Diogenes of Apollonia), τοῖσι δ' αὖ θνητοῖσιν οὗτος αἴτιος τοῦ τε βίου καὶ τῶν νοσέων τοῖς νοσέουσι. A man can live for three or four days without any other τροφή, and breathing is the only function which goes on without intermission. Hence (i. 573) οὐκ ἄλλοθέν ποθεν εἰκός ἐστι γίνεσθαι τὰς ἀρρωστίας μάλιστα ἢ ἐντεῦθεν, ὅταν τοῦτο ἢ πλέον ἢ ἔλασσον ἢ καὶ ἀθροώτερον καὶ μεμιησμένον νοσεροῖσι μιάσμασιν ἐς τὸ σῶμα ἐσέλθῃ. He then proceeds to an 'induction' which is to establish the point that πνεῦμα is the primary source of various diseases in detail, and winds up his essay (i. 586) by saying that all other conditions are merely συναίτια καὶ μεταίτια (accessory causes of disease), τὸ δ' αἴτιον τῶν νούσων ἐὸν τοῦτο ἐπιδέδεικταί μοι. φλέγμα and χολή as causes of disease are too commonly mentioned in the *corpus* to call for any special illustration. I may just refer to the περὶ τῶν ἐντὸς παθῶν, περὶ παθῶν, περὶ νόσων β̄, as examples of works in which the attempt is made to connect specific diseases with specific wrong conditions of these secretions.

84 d 7–8. εἰς τὸ μέσον . . . ἐναπολαμβάνεται. διάφραγμά τ' ἰσχον is a further description of τὸ μέσον. The πνεῦμα is 'shut up' (ἐναπολαμβάνεται) or 'intercepted' in the mid-region which contains the 'party-wall' (see 70 a 1–2).

84 e 1–2. νοσήματα . . . ἀλγεινὰ μετὰ πλήθους ἱδρῶτος. T. clearly refers to πνεῦμα various bronchial affections as well as pulmonary consumption. The reference to consumption explains the words of d 5 τὰ μὲν οὐ τυγχάνοντα ἀναψυχῆς σήπει; the consumption is supposed to be due to the fact that, as the bronchial passages are choked up, cool air cannot get in to replace that which is now over-heated. The 'copious sweat' is a well-known symptom of 'consumption'.

84 e 2–9. πολλάκις . . . προσερρήθησαν. The various forms of disease characterized by unnatural contraction and rigidity of the muscles, tetanus and the like, are also accounted for by local accumulations of *πνεῦμα* which cannot find a natural exit. As M. says, Timaeus, knowing nothing of the function of the nerves, does not suspect the nervous system itself of being the seat of these disorders, he looks for it in the muscles and tendons where the symptoms are exhibited.

84 e 3. διακριθείσης σαρκός. T. does not explain the cause of this separation or division of the flesh. His general conception seems to be that whenever an abnormal 'division' or cavity is formed within the flesh, wind collects to fill it, and is unable to find a proper outlet. This causes a state of things which is distressing, as it means unnatural pressure or tension on the walls of the cavity. There is the same strain on the parts affected as there is in the *thorax* in the cases already considered. The case where the strain affects the *νεῦρα* and their connected blood-vessels is the gravest. The wind, apparently, gets into these *φλέβια* and so swells the *ἐπίτονοι* and *νεῦρα*, and this is the cause of the unnatural contractions.

84 e 6. τοὺς ἐπιτόνους. The word properly means the 'back-stays' of a mast (*Odyssey* μ. 423). Hence its use, by a natural metaphor, for the great sinews of the shoulder and arm, Aristot. *Hist. Animal.* Γ. $515^b 6$ *μέγιστα δὲ μέρη τῶν νεύρων τό τε περὶ τὸ μόριον τὸ τῆς ἄλσεως κύριον, καὶ ἕτερον νεῦρον διπτυχές, ὁ τένων, καὶ τὰ πρὸς τὴν ἰσχὺν βοηθητικά, ἐπίτονός τε καὶ ὠμιαία.* Professor D'Arcy Thompson says that the precise anatomical meaning of *ἐπίτονος* in these passages is unknown. In *Laws* xii. 945 c 4–5 *ἐντόνους τε καὶ ὑποζώματα καὶ νεύρων ἐπιτόνους* the word is apparently used more generally for the tendons or muscles connected with various *νεῦρα*. As Ar. is making a great point in the passage quoted from the *H. A.* of the fact that the *νεῦρα* do not form a single 'continuous' *φύσις*, one may suspect that he has the words of T. *καὶ τὰ συνεχῆ νεῦρα* in his mind, though T. does not mean to affirm that the *νεῦρα* are a single interconnected system. He speaks only of the *νεῦρα* which are connected with the 'back-stays' just mentioned.

84 e 9. τέτανοί τε καὶ ὀπισθότονοι. T. means that the technical names are actually derived from *τείνω*, and have been given because of the unnatural rigidity and curvature of the *νεῦρα* in these disorders. It is not clear why he says nothing of the case of unnatural curvature in the opposite sense (presumably it is included under *τέτανος*. So *τέτανος* and *ὀπισθότονος* are similarly conjoined in the Hippocratean *περὶ νόσων γ̄*, Kühn ii. 302–3).

84 e 9—85 a 1. ὧν καὶ τὸ φάρμακον . . . λύουσιν. That is, art rarely, if ever, effects a cure. When a cure occurs, it is usually due to the *vis medicatrix naturae*. That in such cases the malady ends by fever is stated, as M. remarks, also in the Hippocratean *Aphorisms* (Kühn iii. 735). *λύειν*, as he also observes, is regularly used in the Hippocratean *corpus*, as here, of the fortunate termination of an attack. That disorders of *νεῦρα* are peculiarly refractory to treatment is mentioned in the *περὶ τόπων τῶν κατ' ἄνθρωπον* (Kühn ii. 107), where *τέτανοί τε καὶ ἄλλα ἀφ' ὧν τρόμος τὸ σῶμα λαμβάνει καὶ τρέμειν ποιεῖ* are given as illustrations.

85 a 1–5. τὸ δὲ λευκὸν . . . ἀποτίκτον. Accumulations of λευκὸν φλέγμα are troublesome because of the 'wind' contained in the bubbles made by this secretion. When this wind can get out of the body, the consequences are less serious, being mere discolourations of the skin, such as λευκαί and ἀλφοί, which, it is implied, are disfiguring but not painful or dangerous. What the 'kindred' νοσήματα are we see from many passages in the Hippocratean *corpus* where λειχῆνες or λέπρα, or both, are named along with λεῦκαι or ἀλφοί. None of these are precisely described, but it is clear that they are all mere disfigurements of the skin. λέπρη and λειχήν are specially mentioned in Hipp. περὶ νόσων ᾱ (Kühn ii. 168) as not fatal ἢν μή τι αὐτοῖσι προσγένηται, 'apart from complications'. So in περὶ παθῶν (Kühn ii. 409) λέπρη, κνησμός, ψώρη, λειχῆνες; ἀλφός, ἀλώπεκες are all said to be αἶσχος (disfigurements) μᾶλλον ἢ νουσήματα. As to the cause of these troubles, the περὶ παθῶν (loc. cit.) puts them all down to φλέγμα. In προρρητικῶν β̄. (Kühn i. 233) we get a rather different view, λεῦκαι are said to be formed in consequence of consumption and other very fatal complaints, but λέπρα and λειχήν as a result of μέλαινα χολή. The Eleatic speaker of the *Sophistes* makes a similar distinction between νόσος and αἶσχος in the ψυχή, 227 d 13 δύο μὲν εἴδη κακίας περὶ ψυχὴν ῥητέον.—ποῖα;—τὸ μὲν οἷον νόσον ἐν σώματι, τὸ δ' οἷον αἶσχος ἐγγιγνόμενον. It is explained that the milder evil, the 'disfigurement' in this case is ἄγνοια, the more serious πονηρία. Perhaps it is worth noting that Hipp. περὶ παθῶν makes a point of denying that the λευκὸν φλέγμα of the physicians is itself specially white. It is no whiter than φλέγμα in a healthy body, but the undue accumulation of φλέγμα makes the blood watery and so gives a pallor to the patient's complexion (Kühn ii. 396). The view here denied is precisely that affirmed by Timaeus at 83 d 1–5.

85 a 5–b 2. μετὰ χολῆς . . . λέγεται. λευκὸν φλέγμα + μέλαινα χολή may actually invade the brain and disturb the divinest thing in the body, the circles in the head. The resulting malady is epilepsy, which well deserves its popular name of the 'holy disease', because it is a disease of so holy a substance. The remark that in milder cases the attacks may occur wholly at night, when the patient is asleep (in which case the disease often goes a long time unsuspected), is repeated by modern pathologists. But I suspect that M. is right in supposing that T. means to reckon common nightmare among the milder forms of epilepsy. The real origin of the name 'holy disease' is to be found in the suddenness and apparent causelessness of the violent seizure and the strange cries and convulsions of the sufferer. These suggest at once that the epileptic is suffering from the 'invasion' of a supernatural power, and he is regarded as 'holy' because he is for the time the vehicle of this power, just as where the belief in 'evil spirits' is held, he is regarded as 'possessed' by a fiend. Timaeus's justification of the popular name ἱερὰ νόσος is playful. The best-known classical description of the disorder, the Hippocratean περὶ ἱερῆς νόσου begins with a famous protest against the name and the superstitious attempts to effect cures by spells and charms (Kühn i. 587). 'As to the so-called holy disease, the case stands thus . . . Men fancied it and its cause supernatural (θεῖον) from inexperience and surprise at

its difference from other disorders . . . But if it is thought to be supernatural because of its strangeness, so far as that goes there will be many "holy" diseases, for I will point out others just as strange which no one fancies "holy". . . . My belief is that those who first called this disease "holy" were men such as we see to-day, wizards and purifiers and mountebanks and quacks' (*μάγοι τε καὶ καθαρταὶ καὶ ἀγύρται καὶ ἀλαζόνες*; the description is meant to insinuate the writer's opinion of Empedocles and his followers as being no better than 'shamans' and 'medicine-men'.) 'So they made the supernatural (*τὸ θεῖον*) a cloak for their own helplessness (*ἀμηχανίη*) and inability to produce a remedy, and reckoned this disorder holy to prevent the detection of their own want of science (*ὡς μὴ κατάδηλοι ἔωσιν οὐδὲν ἐπιστάμενοι*). By the repetition of this convenient tale they reduced the treatment to something safe for themselves, using purifications and charms and abstention from warm baths and from many kinds of food unsuitable for invalids . . . and forbidding their patients to wear black clothes, as black is the colour of death, or to wear or sleep in a goatskin, or to cross their hands or feet. . . . They add these regulations in the name of the supernatural, as though they had some special knowledge of that (*ταῦτα δὲ πάντα τοῦ θείου εἵνεκεν προστιθέασιν ὡς πλέον τι εἰδότες*), but it is an empty pretence intended to bring them credit for skill if their patients recover, but if they die, to serve as a defence and a plea that the fault lies not with the practitioner but with the gods. For how can the practitioner be to blame, when he gave his patient no remedy to eat or drink and fomented him with no warm bathing? . . . I hold that this disease is no more holy than another, but arises in the same way as all others and is curable just like them, unless indeed it has become inveterate by lapse of time and too strong for the remedies exhibited.' His own theory is that the disease has its seat in the brain and is due to *φλέγμα* accumulating in the blood-vessels of the brain (Kühn i. 595 *αἴτιος ὁ ἐγκέφαλος τούτου τοῦ πάθεος ὥσπερ καὶ τῶν ἄλλων νουσημάτων τῶν μεγίστων*). The 'divine' and 'intelligent' element in us is 'air', which fills the cavities of the brain (*ὁ δὲ ἐς τὰς φλέβας ἀὴρ ξυμβάλλεται ἐς τὰς κοιλίας εἰσιὼν καὶ ἐς τὸν ἐγκέφαλον, καὶ οὕτω τὴν φρόνησιν καὶ τὴν κίνησιν τοῖσι μέλεσι παρέχει*, Kühn i. 600). Accumulations of *φλέγμα* in the cerebral cavities naturally interfere with the free circulation of 'air' and also chill and freeze the blood (*φλέγμα* being regarded as 'cold'). Hence the loss of consciousness and motion. From the general agreement of this with the brief statement of T., except for the fact that the latter brings *μέλαινα χολή* also into his account, we may infer that the Sicilian medical school held the same general view, though the attack on 'wizards and mountebanks' in the *περὶ ἱερῆς νόσου* probably has Empedocles in view in its allusions to 'persons of that sort at the present time'. In the *περὶ φυσῶν* (Kühn i. 583) epilepsy, like all other disorders, is traced to 'wind', the theory being that 'wind', by affecting the *blood*, affects consciousness and motion (loc. cit. *ἡγέομαι δὲ ἔμπροσθεν μηδὲν εἶναι μᾶλλον τῶν ἐν τῷ σώματι ξυμβαλλομένων ἐς φρόνησιν ἂν ἢ τὸ αἷμα . . . ἐξαλλάσσοντος δὲ τοῦ αἵματος μεταπίπτει καὶ τὸ φρόνημα . . .* Hence *ὅταν πολὺ πνεῦμα κατὰ πᾶν τὸ σῶμα παντὶ τῷ αἵματι μιχθῇ πολλὰ ἐμφράγματα γίνεται πολλαχῇ ἀνὰ τὰς φλέβας*, and an epileptic seizure is the conse-

quence, ib. i. 584). Since Empedocles is responsible for the doctrine that we 'think with the blood' (*αἷμα γὰρ ἀνθρώποις περικάρδιόν ἐστι νόημα*), this may well have been the original Sicilian view; T.'s version and that of the *περὶ ἱερῆς νόσου* represent the attempt to square Empedoclean biology with Alcmaeon, and, in the case of the latter work, with the view of Anaximenes about the primary substance, revived in the fifth century by the Apolloniate Diogenes. Both the *περὶ ἱερῆς νόσου* and the *περὶ φυσῶν* seems to be influenced by Diogenes; in the *περὶ ἱερῆς νόσου* the persons specially aimed at in the polemic (Kühn i. 613) against those who hold *ὡς φρονέομεν τῇ καρδίῃ καὶ τὸ ἀνιώμενον τοῦτό ἐστι καὶ τὸ φροντίζον* are pretty clearly the followers of Empedocles. We know from the *Phaedo* that his theory on the point was a matter of discussion in the youth of Socrates. The author of the 'spurious' second Hippocratean book 'on acute disorders' also affords interesting points of contact with Timaeus. He accounts for epilepsy as due to 'wind in the veins' (so far agreeing with the *περὶ φυσῶν*), plus an inundation of 'black bile' (*περὶ διαίτης ὀξέων νόθα*, Kühlewein, i. 149).

Aristotle mentions the fact that in mild forms of the disease the attacks may be confined to the period of sleep (*de Somno* 457ª 9, ff.), in order to make out his view that both epilepsy and sleep, which is 'in a way' an epilepsy, are due to the excessive refrigeration of the region of the heart by the redescent of 'vapours' which have been cooled in the region of the brain (*ὅμοιον γὰρ ὁ ὕπνος ἐπιλήψει, καὶ ἔστι τρόπον τινὰ ὁ ὕπνος ἐπίληψις. διὸ καὶ συμβαίνει πολλοῖς ἡ ἀρχὴ τούτου τοῦ πάθους καθεύδουσιν, καὶ καθεύδοντες μὲν ἁλίσκονται, ἐγρηγορότες δ' οὔ*).

85 b 2–5. φλέγμα δ' ὀξὺ . . . εἴληφεν. That is, all 'catarrhs' or 'fluxes' are due to 'acid' *φλέγμα*. The various 'fluxes' are named according to the part of the body to which the fluxion is directed. As the aetiology is in all cases in principle the same, T. does not think it necessary to specify the different 'fluxes'. The best illustration, perhaps, is afforded by the elaborate doctrine of various 'fluxes' and their consequences given in Hipp. *περὶ τόπων κατὰ ἄνθρωπον*, Kühn ii. 114 ff., where we are told that there are discharges from head to ears, eyes, nostrils, thorax. The last is the cause of 'consumption'. There may also (ib.) be a discharge to the *μυελός* (presumably *tabes dorsalis*). Dropsy, again, arises *ὅταν ὄπισθεν ἐς τοὺς σπονδύλους καὶ ἐς τὰς σάρκας ῥυῇ* (ib.). Even the acute diseases, pneumonia (*περιπλευμονίη*) and pleurisy (*πλευρῖτις*) are said by this writer to be caused by *ῥόοι*, which turn to 'black bile' (op. cit. 121).

85 b 5–7. ὅσα δὲ . . . γέγονε πάντα. 'Inflammatory' disorders of all kinds are due to *χολή*, and not, as you might suppose from the name, to *φλέγμα*. Thus T. rejects Philolaus's etymological argument for the view that *φλέγμα* is 'hot', though it is noticeable that he does not say that Philolaus was wrong as to the *fact*. He abstains from any suggestion of the more common view (adopted by the 'humoral' pathologists) that *φλέγμα* is cold, and this can hardly be unintentional. If he does not mean to agree with Philolaus on the point, he means at the least to leave the question open. He now proceeds to the maladies which, according to him, are due to *χολή*.

85 b 7–c 7. λαμβάνουσα . . . φλεψίν. There are two cases to be considered. (1) The accumulation of bile may find a 'vent' (*ἀναπνοή*), and then it merely produces *φύματα*, inflammatory growths on the surface of the body, superficial 'tumours'. (2) Or it may be wholly confined to the internal parts, and then the result is more serious. It causes many 'inflammatory' disorders' (*πυρίκαυτα νοσήματα*). This, no doubt, is intended to include in particular the inflammatory disorders which seem to have been specially common and dreaded, if we may judge from the Hippocratean treatises, pneumonia (*περιπλευμονίη*), pleurisy (*πλευρῖτις*), and inflammation of the brain (*φρενῖτις*). Burning fever (*καῦσος*) is also reckoned among the graver *ὀξεῖαι νόσοι*, e.g. in Hippoc. *περὶ παθῶν*, Kühn ii. 385.[1] It is accounted for (ib. ii. 389) as due to the settling of *χολή* in the interior of the trunk. In the same work (ii. 388) *φρενῖτις* is said to be caused by *χολή* when it attacks the *σπλάγχνα* or *φρένες*. In *περὶ νόσων ᾱ* (Kühn ii. 209) *φρενῖτις* is similarly referred to *χολή* (*φρενῖτίς τε ὧδε ἔχει. τὸ αἷμα τὸ ἐν τῷ ἀνθρώπῳ πλεῖστον ξυμβάλλεται συνέσιος, ἔνιοι δὲ λέγουσι τὸ πᾶν* (the Empedoclean doctrine) . . . *ὁκόταν οὖν χολὴ κινηθεῖσα ἐς τὰς φλέβας καὶ ἐς τὸ αἷμα εἰσέλθῃ διεκίνησε καὶ διούρησε τὸ αἷμα ἐκ τῆς εἰωθυίας συστάσιός τε καὶ κινήσιος καὶ διεθέρμηνε. διαθερμανθὲν δὲ διαθερμαίνει καὶ τὸ ἄλλο σῶμα πᾶν καὶ παρανοεῖται ὁ ἄνθρωπος καὶ οὐκ ἐν ἑωυτῷ ἐστιν.* Hence delirium presents resemblances to 'melancholy', being due to the same cause, the presence of *χολή* in the blood. This account of *φρενῖτις* is in general keeping with what T. says below at e 2–7).

85 c 3. τὸ τῶν ἰνῶν γένος. Thus the accumulation of *χολή* produces its evil effects by hindering the fibrine of the blood from discharging its function, which is to prevent that fluid from being either too thin or too thick. If the blood is overheated and too thin, it will escape through the *πόροι*; if it is too thick and sluggish, it will not circulate as rapidly as it ought, but tend to become stagnant. The *ἶνες* are interspersed to maintain the 'right mean' in these respects (*καιρὸν τούτων φυλάττουσιν*).

85 d 2–5. ἃς ὅταν . . . συμπηγνύασιν. Thus Timaeus knows that *after death* blood which retains its fibrine coagulates, whereas defibrinated blood does not. But how is this to be reconciled with his positive statement above (82 d 1) that defibrinated blood does congeal? I cannot help thinking that the contradiction has been caused by reliance on more than one 'source', not all equally trustworthy on all points.

85 d 6–7. χολὴ παλαιὸν αἷμα . . . τετηκυῖα. Here, again, it seems to be assumed that *χολή* is always a 'morbid' secretion.

85 e 1–2. πηγνυμένη . . . παρέχει. This is meant to account for the high temperature and shivering with which an attack of one of the 'acute diseases' is attended. *χολή* is itself 'hot and moist' (after all it is, according to T., a product of the blood), and as small quantities of it infect the blood-vessels, is consequently coagulated and made cooler by the presence of the fibrine. So at the onset of one of these disorders, the patient feels chilled and shivers. Cf. the explanation of the shivering of

[1] Cf. also Hipp. *περὶ διαίτης ὀξέων* 5 (Kühlewein i. 111) *ἔστιν δὲ ταῦτα ὀξέα, ὁποῖα ὠνόμασαν οἱ ἀρχαῖοι πλευρῖτιν καὶ περιπνευμονίην καὶ φρενῖτιν καὶ καῦσον, καὶ τἆλλα ὅσα τούτων ἐχόμενα.*

a fever patient in Hipp. *περὶ νόσων* ā (Kühn ii. 200–1) *ὁκόταν χολὴ ἢ φλέγμα θερμανθῇ, θερμαίνεται τὸ ἄλλο πᾶν σῶμα ἀπὸ τούτων καὶ καλέεται τοῦτο πυρετός . . . ψυχρότατον γὰρ φύσει τὸ φλέγμα, θερμότατον δὲ τὸ αἷμα· ψυχρότερον δέ τι καὶ ἡ χολὴ τοῦ αἵματος. ὅταν οὖν ταῦτα συμμιχθῇ ἢ ἀμφότερα ἢ τὸ ἕτερον εἰς τὸ αἷμα, πήγνυσι τὸ αἷμα, οὐ παντάπασι δέ, . . . ψυχομένου οὖν τοῦ αἵματος, ἀνάγκη ψύχεσθαι καὶ τὸ ἄλλο σῶμα, καὶ καλέεται ῥῖγος ὁκόταν* [*τοῦτο*] *τὸ τοιοῦτον γένηται.* But here, in accord with the view that *αἷμα* is the 'hottest' constituent in the body, it is the *φλέγμα* or *χολή* which is supposed to 'freeze' the blood, whereas T., regarding *χολή* as the hottest constituent, naturally makes the blood congeal the *χολή*.

85 e 2–7. πλείων δ' ἐπιρρέουσα . . . ἐλευθέραν. This is the case of the severest of the maladies due to *χολή*. The blood is absolutely saturated with *χολή* and the fibrine unable to do its task of maintaining the blood at an equable temperature. That is, there is an acute disease accompanied by high temperature. If the heat affects the *μυελός*, the result is death. Presumably T. is thinking here of pneumonia, pleurisy, 'phrenitis', all regarded, as we see from the Hippocratean books, as particularly deadly, and all exhibiting the symptoms which are here traced to *χολή*. In the words *εἰς ἀταξίαν ζέσασα διέσεισεν* we have a reference to the rapid and disordered pulse which is characteristic of all these disorders; the spread of the trouble to the *μυελός*, which composes the brain as well as the spinal cord, is meant to account for the attendant delirium. In l. 6 *αὐτόθεν*, 'on the spot', alludes to the rapidity with which the victim succumbs. The *πείσματα* are, of course, like the *δεσμοί* of 73 d 6, purely metaphorical. *τὸ τοῦ μυελοῦ γένος* is the usual periphrasis for *τὸν μυελόν*.

85 e 7—86 a 2. ὅταν δ' ἐλάττων . . . παρέσχετο. When the accumulation of *χολή* in the blood is not so great or the constitution of the sufferer stronger, the issue of the disease may not be fatal. The attack may pass off in either of two ways. The morbid secretion may be carried off *κατὰ πᾶν τὸ σῶμα*, i. e. through the *πόροι* of the skin at large. If the patient is kept properly warm and otherwise rightly treated, he may fall into a sweat and recover. (Cf. Hipp. *περὶ διαίτης ὀξέων* [*νόθα*] 15, Kühlewein i. 166 *τὰ δὲ νοσήματα πάντα λύεται ἢ κατὰ στόμα ἢ κατὰ κοιλίην ἢ κατὰ κύστιν· ἡ δὲ τοῦ ἱδρῶτος ἰδέη κοινὸν ἁπάντων.*) Or the *χολή* may make its way into the bowels and be expelled thence. Attacks of dysentery and diarrhoea find their explanation in this. Cf. Hipp. *περὶ παθῶν* (Kühn ii. 401) where dysentery is traced to the settling of *χολή* and *φλέγμα* in the veins and the *κοιλίη*, *λειεντερίη* to the discharge of a 'flux' of *φλέγμα* from the head and *ἄνω κοιλίη* into the *κάτω κοιλίη*, and ib. ii. 402 when a similar cause is assigned for obstinate diarrhoea. It is clear from the context that T. is not regarding dysentery and diarrhoea themselves as inflammatory disorders, but as attendant symptoms of the expulsion of an *ὀξεῖα νόσος* from the system.

85 e 9. ἐξέπεσεν. T. is playing on the two meanings of the word, the literal and the political. We speak of 'expelling' a morbid secretion from the body, and equally of 'expelling' a *mauvais sujet* from the commonwealth (*ἐκπίπτειν* being the regular word for 'to be banished the country'). The expelled *χολή* is thought of as a rebel element which is

expelled by the lawful authority, when that authority has 'got the upper hand' in the conflict (*κρατηθεῖσα*, e 8). The thought that disease is 'anarchy' or 'rebellion' (*στάσις*) in the *πόλις* of the body is kept up. So the metaphor is probably felt in the *συνωσθεῖσα*, which suggests a body of insurgents first driven in street fighting into a corner of the *πόλις* and then finally turned out of the territory altogether. The picture becomes explicit in the next words *οἷον φυγάς κτλ.*

86 a 2–8. ***τὸ μὲν οὖν . . . μόλις.*** These remarks about fevers form no part of the account of the diseases caused by *χολή*. As the fevers are traced back to the undue *πλεονεξία* of one or other of the 'four roots', they must evidently be intended as illustrations of the disorders which belong to the first of T.'s three classes. He gave no examples of these when he was describing the general character of this class of maladies; he now appends to his sketch of pathology the examples which were missing at the point where they should have come in. Again, we must feel that Plato is not altogether 'in his element'; the whole topic of pathology is treated in a way which suggests that he did not feel at home with the subject. In what follows the reference is to ordinary 'fevers' or 'agues', not to the intense fever which is symptomatic of one of the *ὀξεῖαι νόσοι*. This, known as *καῦσος*, is itself usually reckoned as one of the four chief 'acute disorders'. Nor does T. anywhere take account of *λοιμοί*, diseases supposedly conveyed by infection of the air or water. This accounts for his silence about 'typhus', unless, indeed, like the author of Hipp. *περὶ τῶν ἐντὸς παθῶν* (Kühn ii. 496–505) he regards these 'putrid fevers' as due to 'corruptions' of *χολή* or other *ὑγρά* in the body.

As to the 'fevers', the main distinction is between 'continuous' (*συνεχεῖς*) and 'intermittent' (*διαλείποντες*), i. e. those in which the 'hot fits' are interrupted by an interval of freedom from fever. The technical names for the different 'intermittent' fevers are based upon the length of time required for a recurrence of the hot fit. If it recurs with less than a day's interval, the fever is called an *ἀμφημερινός* (quotidian); when there is a full day of relief, the fever is *τριταῖος* (a tertian), because its character cannot be diagnosed without waiting until the third day; if the interval is two days, the fever is called *τεταρταῖος* (quartan), the denomination being thus in each case taken from the number of days, reckoned inclusively, from one hot fit to the next. T. then works in the doctrine of the 'roots'. Non-intermittent fevers are due to excess of fire, the hottest element in our make-up, quotidians to excess of air, the next hottest, tertians to excess of water, quartans to excess of earth; all are thus examples of Alcmaeon's doctrine that disease is the *μοναρχίη* or *πλεονεξίη* of some one constituent. The excess of *any* element whatever is supposed to cause fever. This looks like adhesion to the view of Philolaus that 'the cold' plays no part in the human organism. As for verbal points, the *τὸ δέ* of a 4 and 5 stand for *τὸ δ' ἐξ ἀέρος* and *τὸ δ' ἐκ γῆς* ⟨*ὑπερβολῆς νοσῆσαν σῶμα*⟩, and *τετραπλασίαις περιόδοις* means 'in periods four times the length ⟨of the one first mentioned⟩. A quotidian can be diagnosed for what it is in one day; you have to wait until the fourth day to recognize a quartan. We may contrast with this account that of the *περὶ φύσιος ἀνθρώπου*, an exposition of the 'humoral' pathology,

according to which all these fevers are due to excess of χολή, the continuous to the greatest, the quartan to the least degree of excess (Kühn i. 369 *οἱ πλεῖστοι τῶν πυρετῶν γίνονται ἀπὸ χολῆς. εἴδεα δὲ σφέων εἰσὶ τέσσαρα . . . ὀνόματα δ' αὐτέοισίν ἐστι ξύνοχος, ἀμφημερινός, τριταῖος, τεταρταῖος. ὁ μὲν οὖν ξύνοχος καλεόμενος γίνεται ὑπὸ πλείστης χολῆς καὶ ἀκρητεστάτης* κτλ.), or again the view taken in *περὶ νόσων* ᾱ (Kühn ii. 200) that the two causes of fever are χολή and φλέγμα. So in *περὶ παθῶν* (Kühn ii. 395) tertians and quartans are said to be due to χολή and φλέγμα. All these views disagree with that of T. in being adapted to the 'humoral' pathology, whereas T. connects the four classes of fevers directly with the Empedoclean 'roots'. The 'humoral' pathology does not *necessarily* involve the doctrine of the 'roots' at all, though it was natural that the attempt should be made to identify each 'root', as well as each humour, with a particular 'blend' (κρᾶσις) of 'opposites' (ἐναντία).

As has been said, the account of diseases and their causes given by T. does not appear in any of the extant remains of Greek medicine; the coincidences we have noted are in points of detail. It was not to be expected that a synthetizer of Pythagorean dualism with Empedoclean pluralism would accept a theory like that of the *περὶ φυσῶν*, which makes πνεῦμα the only cause of all disorders, or even like that of the Heracliteanizing *περὶ διαίτης* ᾱ, β̄, where the 'opposites' in the human frame are reduced to a single pair, fire and water. The Empedoclean influence on a Sicilian contemporary of Socrates was bound to prevent that. It is probably the strength of this influence also which explains T.'s rejection of the 'humoral' pathology of Cos, as we get it in the *περὶ φύσιος ἀνθρώπου*. He is determined not to take the 'humours' as ultimates, but to derive them from something simpler. For the same reason we should not expect to find him tracing all disease, apart from that which is due to wounds and similar injuries, to χολή and φλέγμα, like the author of *περὶ νόσων* ᾱ (Kühn ii. 167 *αἱ μὲν οὖν νοῦσοι γίνονται ἅπασαι τῶν μὲν ἐν τῷ σόματι ἐνεόντων ἀπό τε χολῆς καὶ φλέγματος, τῶν δὲ ἔξωθεν ἀπὸ πόνων καὶ τρωμάτων*). The doctrine he puts forward, though not wholly clear or coherent, is what we should expect from a speculative thinker anxious to fuse Pythagoras and Alcmaeon with Empedocles. Hence it is probably deliberately based by Plato on actual syntheses of this kind attempted by fifth-century Italian or Sicilian teachers.

It is interesting to examine briefly the assault made by Galen, a convinced believer in the Coan 'humoral' pathology, on the whole treatment of disease in this section of the *Timaeus*. What he has to say will be found in Bks. VII–VIII of the *de Hippocrat. et Platon. placitis*, and it must be remembered that the criticism comes from a physician who is in general an admiring adherent of Plato. His quarrel with Plato is precisely that he did not take the 'humoral' pathology as the foundation of the medical sections of the dialogue. Galen finds the clearest exposition of this pathology in the *περὶ φύσιος ἀνθρώπου*, which he regards as the actual work of Hippocrates.[1] His general view is that Plato had the *περὶ*

[1] Those modern scholars who assign the work to Polybus do so on the strength of Aristotle's express ascription to him of the description of the vascular system (Kühn i. 364–6). Galen argues that this section is an irrelevant interpolation.

φύσιος ἀνθρώπου before him and meant to follow the doctrine of Hippocrates, but fell into the sort of mistake to be expected in a layman who is trying to 'popularize' science. The actual words of the περὶ φ. ἀ. on which Galen is building run as follows: τὸ δὲ σῶμα τοῦ ἀνθρώπου ἔχει ἐν ἑαυτῷ αἷμα καὶ φλέγμα καὶ χολὴν ξανθήν τε καὶ μέλαιναν καὶ ταῦτά ἐστιν αὐτῷ ἡ φύσις τοῦ σώματος καὶ διὰ ταῦτα ἀλγέει καὶ ὑγιαίνει. ὑγιαίνει μὲν οὖν μάλιστα ὅταν μετρίως ἔχῃ ταῦτα τῆς πρὸς ἄλληλα κρήσιος καὶ δυνάμιος καὶ τοῦ πλήθεος καὶ μάλιστα μεμειγμένα ᾖ· ἀλγέει δὲ ὅταν τι τούτων ἔλαττον ἢ πλέον ᾖ ἢ χωρισθῇ ἐν τῷ σώματι καὶ μὴ κεκρημένον ᾖ τοῖσι πᾶσι (Kühn i. 352–3). Plato, he says (op. cit. viii. M. 678 = K. 676) βούλεται ἀκολουθεῖν, intends to follow, this statement. Unfortunately he thinks it necessary to bring the 'humours' into correspondence with the Empedoclean roots, whereas (op. cit. vii. 666 = K. 664) Hippocrates rightly disregards the speculative construction of the 'roots' as irrelevant to medicine. There is a general correspondence of μέλαινα χολή with γῆ (cold and dry), of φλέγμα with ὕδωρ (cold and moist), and of ξανθὴ χολή with πῦρ (hot and dry), but Galen feels a difficulty about making αἷμα correspond with ἀήρ. Hence he prefers the statement of the περὶ φ. ἀ., which says nothing about the composition of the human body out of Empedoclean 'roots', as more scientific than the physiology of Timaeus (op. cit. viii. 679 = K. 676). He regards the words of Timaeus at 82 a 3, where one cause of disease is said to be τῆς χώρας μετάστασις ἐξ οἰκείας ἐπ' ἀλλοτρίαν γιγνομένη as an actual *paraphrase* of the clause ἢ χωρισθῇ κτλ., in the passage just cited from περὶ φ. ἀ., but he supposes the words which follow in Plato πυρός τ' αὖ κτλ. to be a layman's mistaken interpretation of what had gone before (thus erroneously taking them for an exegesis and not for a fresh statement), op. cit. viii. 681 (= K. 678) ὅπερ ὁ Πλάτων παραφράζων ἔφη "καὶ . . . γιγνομένη"· ἀλλ' οὗτος μέν, ὡς ἔφην, ἁμαρτάνει προσθεὶς "πυρός τ' αὖ . . . τυγχάνει" ταῦτα γὰρ οὐκ ἔστι τὰ μεθιστάμενα καὶ χώραν ἀμείβοντα κατὰ τὰ τῶν ζῴων σώματα, φλέγμα δὲ καὶ χολαὶ καὶ αὐτὸ τὸ αἷμα. That is, he holds that the introduction of the 'roots' as πρῶται συστάσεις is a misunderstanding. For physiology and medicine the πρῶται συστάσεις should be the four 'humours'. They, not the 'four roots', should have been the ultimates of pathology. He further holds the unlikely view that Plato was led into *his* statement about the πρῶται συστάσεις and the derangements of them by misunderstanding the language of the περὶ φ. ἀ. Further, he goes on to argue, the statement of T. is false in fact. Improper accumulations of the four 'humours' do cause specific diseases; ξανθὴ χολή gives rise to eruptive disorders, ἐρυσιπέλατα and ἕρπητες (neither mentioned by T.), μέλαινα χολή to cancers, φλέγμα to tumours (ascribed by T. at 85 c 1 to χολή), αἷμα to consumption, when the excess of blood is in the lungs, and so on. But you never find, as you should if T. were right about the πρῶται συστάσεις, accumulations of pure earth, water, or fire in the human body, and φῦσαι, which you do find, are not mere air but always contain ὑγρὸν ἰκμάδα (op. cit. viii. 682–3 = K. 678–9). Coming to T.'s account of the δεύτεραι συστάσεις, Galen blames Plato severely for putting αἷμα (which is a πρώτη σύστασις in the 'humoral' pathology), on the same level as σάρξ and νεῦρα (op. cit. vii. 683–4 = K. 680), οὐκ ὀρθῶς δὲ αὐτοῖς συγκατέλεξε τὸ αἷμα πρώτην ἔχον, οὐ δευτέραν

σύστασιν. He thinks Plato felt the incongruity himself, and that this is why he inserted the words ἄλλον μὲν τρόπον in 82 c 3. I have noted myself that T.'s statements about the relation of αἷμα to σάρξ do not seem consistent with one another, but in Galen's criticism it seems to me there is a wholly unjustifiable attempt against the evidence to force on Timaeus the derivation of the ὁμοιομερῆ from the four 'humours'. There is no word of any such derivation in the dialogue. It is likely enough that Plato has drawn on the περὶ φ. ἀ., but what Galen will not see is that T. rejects the 'humoral' theory of that work altogether. Further on (viii. 688–9 = K. 685), after saying that most physicians agree with the 'Hippocratic' view about the physical properties of the four χυμοί, though Erasistratus, out of a pique against the fame of the Coan school (πρὸς τοὺς ἀπὸ Κῶ φιλοτιμούμενος), declined to assent to it, Galen complains that Plato has neglected to attend to the proofs given in the περὶ φ. ἀ. that the χυμοί are κατὰ φύσιν and that each of them tends to predominate in one special season of the year, and also in one of the four periods of man's life. (This is in keeping with our own conclusion that T. regards φλέγμα and χολή as definitely *morbid* sensations.) Hence T.'s whole classification of maladies is, according to Galen (op. cit. viii. 701 = K. 696), unscientific. ταύτην τὴν τάξιν τῆς διδασκαλίας (i. e. that founded on the 'humoral' pathology) ἐχρῆν πεποιῆσθαι τὸν Πλάτωνα μᾶλλον, εἴπερ γε φιλοσόφῳ προσήκει τὸ τάξει καὶ μεθόδῳ χρῆσθαι τῆς διδασκαλίας καὶ μᾶλλον ἢ τοῖς ἰατροῖς. He excuses Plato, however, on the ground that he had no specialist knowledge in medicine and that it is to his credit that he pretended to none, καὶ κατὰ τοῦτο ἐπαινεῖν αὐτὸν προσήκει, περὶ ὧν ἀκριβῶς οὐκ ἠπίστατο μηδὲ ἐπιχειρήσαντα λέγειν.

As to special points, Galen complains that what is said at 86 a about recurrent fevers is a piece of pure carelessness. For (*a*) it is a blunder to connect the various kinds of fever with the κοινὰ στοιχεῖα, the 'roots' of Empedocles, (*b*) the statements about quotidians and tertians οὐδὲ ἐγγὺς ἦκε τῆς ἀληθοῦς αἰτίας (viii. 703 = K. 697). For in quotidians there is a manifest excess of φλέγμα, which is cold and moist, in tertians of ξανθὴ χολή, which is dry and extremely hot. So that if the different fevers were to be connected with the Empedoclean 'roots' at all, the τριταῖοι should have been connected with πῦρ and the ἀμφημερινοί with water (op. cit. viii. 703–4 = K. 698).

Again the statement (83 c 7–8) that φλέγμα can be produced ἐκ συντήξεως ἁπαλῆς σαρκός is τῶν ἀτοπωτάτων. It contradicts Plato himself, for it can only be true if by φλέγμα you mean a πικρόχολος χυμός, but Plato himself says that *this* is very *hot* (*Tim.* 85 b 5), whereas φλέγμα is cold. Clearly then by φλέγμα Plato must *mean* a third kind of χολή. (This amounts to a tacit admission that T. regards φλέγμα as hot.) But he is not simply misapplying the *word* φλέγμα, as Galen says Prodicus had done. He really refers to and makes a false statement about the thing which others call φλέγμα, for he mentions its white colour (83 d 5, 85 a 1). Moreover τηκομένη σάρξ is not in fact white but yellowish, ὑπωχρον πυρρόν (op. cit. viii. 705–7 = K. 699–701).

86 b 1—87 b 9. καὶ τὰ μὲν περὶ τὸ σῶμα . . . τρόπος ἄλλος λόγων. *Disease in the soul and its causes.* T. now passes from disorder in the

body to its spiritual analogue, disorder in the soul, *moral* badness. The section contains the most thorough-going exposition to be found in Plato of the constantly repeated doctrine that no one chooses evil, or is 'bad' ἑκών, *exprès*, of set purpose. This doctrine, thanks to the way in which Aristotle associates it with the name of Socrates in the *Ethics*, has commonly come to be called the 'Socratic paradox'. It is not Socratic in the sense of being confined to Socrates or originated by him. Aristotle himself accepts it as completely as any one, though he dislikes the Socratic formula οὐδεὶς ἑκὼν ἁμαρτάνει because the words might be twisted into an excuse for denying a man's responsibility for his own wrong deeds but leaving him free to take all the credit for his good acts. All that is insisted on in the well-known polemic of *E. N.* iii is that we are responsible for our bad acts in the same sense as for our good acts, i. e. it is *we*, not some 'invading personality', or 'subliminal self', at whose door our misdeeds are to be laid. Socrates would no more have denied this than Aristotle does. To avoid all possibility of misinterpretation, Aristotle himself adopts a different formula, 'every one pursues what seems to him to be good, though it is only the good man in whose case the seeming good is also always the real good' (*E. N.* 1114ᵃ 31 εἰ δέ τις λέγοι ὅτι πάντες ἐφίενται τοῦ φαινομένου ἀγαθοῦ, τῆς δὲ φαντασίας οὐ κύριοι, ἀλλ' ὁποῖός ποθ' ἕκαστός ἐστι, τοιοῦτο καὶ τὸ τέλος φαίνεται αὐτῷ· εἰ μὲν οὖν ἕκαστος ἑαυτῷ τῆς ἕξεώς ἐστί πως αἴτιος, καὶ τῆς φαντασίας ἔσται πως αὐτὸς αἴτιος). The doctrine is enforced in the 'Socratic' formulation in the *Laws* (e. g. at iv. 860 d 1 οἱ κακοὶ πάντες εἰς πάντα εἰσὶν ἄκοντες κακοί, and elsewhere), so that it is certainly Plato's own. In the present passage it is expounded by Timaeus and brought into direct connexion with his theory of disease. Plato thus wishes us to believe that it is not his own or Socrates' peculiar doctrine, but part of the 'common good' of the society to which Timaeus belongs, and there is every reason why we should accept this representation. The οὐδεὶς ἑκὼν κακός is the kind of formula which would be likely to originate among medical men, as it is just the same class who are in our own day attracted by the formula that 'crime is a disease'. In fact, the very paradoxicality of the statement makes against the view that it originated with Socrates. Socrates is represented by Plato as never weary of insisting on our responsibility for our conduct and the necessity for making ἐπιμέλεια τῆς ψυχῆς our chief concern, and even the ultra-sceptics have not yet ventured to challenge the historical accuracy of this representation. Such a man would be the most unlikely in the world to express his meaning in a formula which, as Aristotle saw, is so easily made into an excuse for irresponsibility in practice, if the formula had not been already there ready to his hand. We can understand his reading a meaning of his own into it; we cannot really understand his inventing it. There is a further reason for thinking that the formula goes back behind Socrates to men of the type of Timaeus. If we read T.'s exposition of it carefully, I think we shall be struck by a curious fact. His exposition explains away that very fact of moral responsibility on which Socrates, Plato, Aristotle, and Timaeus himself, when he is talking ethics and not medicine, are all anxious to insist. The interpretation he proceeds to give of the formula is therefore non-Platonic and non-Socratic,

and I can see no reason for its introduction at all except the obvious one that such theories were current in fifth-century medical circles. Those who regard the deliverances of T. as all expressions of Plato's views, quite correctly, on their premisses, attribute to Plato a 'determinism' of the kind which makes moral freedom and responsibility illusory. They are right in seeing such a determinism in this section of the dialogue; they go wrong by forgetting that the determinist who speaks is not Plato nor Socrates but Timaeus.

The question at stake is not whether men have a *libertas arbitrii* in the sense of ability to act in either of two alternative ways without any preference for the one against the other. Whether such a *libertas* exists or not, it is no part of the ethics of Socrates, Plato, or Aristotle to assert it. All three agree that if a man chooses at all, he chooses the alternative which seems to him best. Choice is always 'determined' by the agent's estimate of good. But there still remains the question whether any one ever really chooses at all. The plain man believes that he does, and that, as he puts it, how he will act depends on how he 'makes up his mind' to act. Now the whole point of the so-called 'scientific determinists' appears to be that no one ever does 'make up his mind'. Circumstances taken in reaction with a something called 'character', but regularly spoken of as though it were a fixed endowment brought into the wor'd by each of us at birth, all along make up our minds for us. We think we are choosing and that it is our present choosing which determines what we shall do, but this is an illusion; 'choosing' is really discovering that we have no choice left. It is this denial of the efficacy of choice, not the denial of 'free will of indifference' which brings the determinist into collision with moralists who take human conduct seriously. To put the point in a rather different way, the 'scientific' determinist usually holds that my 'choices' express my character and that this character in turn has been partly 'inherited' at birth, partly moulded by the interplay between my 'inherited' endowments and the characters of others who have influenced me. My father and my head master, on this theory, among others, stand to my acts in the same sort of relation as I do myself, the only difference being that I am a proximate, they more remote causes of my conduct. What the moralist who is in earnest is bound to maintain against any position of this kind is that I stand to my conduct in a relation different in kind from that in which my father or my schoolmaster stands to it. That is just why I hold that the acts in question are my acts and not theirs, and that I and not they are responsible for them. If it were not so, the maxim *qui facit per alium facit per se* would be applicable, and there could be no reason why my schoolmaster should not receive an LL.D. for my contributions to knowledge or my father go to prison for my theft. (Kant saw this point clearly, however we may think of his attempt to express it by his distinction between 'free' and 'mechanical' causality in the *Critique of Practical Reason.*) The real solution of the problem, I take it, is to be found along the lines of Aristotle's well-known doctrine of λογικαὶ δυνάμεις which may be developed into either of two opposite qualities. I do not bring into the world any ready-made character, only 'dispositions' which are capable of being developed in opposite directions, and it is

I myself, to a very large extent, who 'determine' by my acts along what lines my 'character' shall grow out of these 'dispositions'. The statement only seems paradoxical because of our inveterate habit of trying to apply to something which is still in the making modes of thinking which are only appropriate to what is already made. The determinist consciously or unconsciously assumes that a man's character is an ὄν, is there, before he makes a given choice, whereas it is in truth ἀεὶ γιγνόμενον, makes itself in the process of choosing. A determinist who is a half-thinker is thus led into the sham 'science' exemplified in Zola's dreary family history of the Rougon-Macquarts; a determinist who is a resolute thinker ends by believing in Schopenhauer's metaphysical absurdity of the unalterable 'intelligible character'. Our problem is to discover what view Timaeus, in his pathological study, takes of this issue, and whether it is the same as that of Socrates and Plato.

Now Timaeus certainly comes very near denying all moral responsibility, since he goes on to assign as the two causes of all moral malady bad congenital physique and bad education, both causes independent of the agent himself, and is actually carried away into saying that our parents and those who educate us, rather than ourselves, deserve the blame for our wrong deeds (87 b 4–6). The existence of this passage does something to excuse Aristotle for the attitude which he takes in the *Ethics*, where he is at pains to represent himself as the champion of moral responsibility against opponents who are clearly recognizable as the Academy. But there is an important point which those who speak of Socrates and Plato as 'determinists' forget. Neither Plato nor Plato's Socrates ever uses the language about responsibility which Timaeus does. T. expressly says that a man's parents and educators are more to blame than the man himself for his misdoings. But the whole point—to take only one example—of the myth of Er is that we ourselves, and no one else, not our Maker, nor our parents, are answerable for the moral quality of our deeds (αἰτία ἑλομένου, θεὸς ἀναίτιος, *Rep.* x. 617 e 4). If any one doubts whether we can argue from the myth of Er to the views of the 'historical Socrates', he may be referred to the *Apology* where Socrates insists that his mission from God is precisely to preach to his countrymen the necessity of ἐπιμέλεια αὐτῶν, the 'making of their own souls'. So the central doctrine of *Laws* x, that ψυχή is the source of *all* motions, is expressly meant to strike at any theory which, like that of Timaeus, finds an ultimate source of moral evil in a physical cause. What is more, the moral pathology of Timaeus is not even consistent with his own utterances earlier in the dialogue. At 42 e 1 ff. the 'created gods' are instructed by their maker to 'steer the course of the mortal creature nobly and well', ὅτι μὴ κακῶν αὐτὸ ἑαυτῷ γίγνοιτο αἴτιον, 'except in so far as it shall be the cause of evil to itself'. This is quite irreconcilable with the view that a constitution which the 'mortal creature' received from these divinities is really to 'blame', rather than itself, for its *crimes passionels*. (And cf. 41 e 4 where we are told of God's care ἵνα μήτις ἐλαττοῖτο ὑπ' αὐτοῦ.) There is a manifest discrepancy between T.'s religion and ethics and his Empedoclean medical psychology, exactly as there is between Spinoza's metaphysical theory of the unreality of evil, which leads him at the

end of *Ethics*, Pt. I, to declare the distinction between good and bad purely subjective, and the moral earnestness of his doctrine of the way to overcome the passions in Pts. IV and V of the same work. The later Platonists, especially Proclus, rightly insist on the point that in the myth of Er and elsewhere Plato is careful to safeguard the reality of moral responsibility (*τὸ αὐτεξούσιον*) by teaching that our choice for good or evil is a co-operating cause of the course of events and is not included, as it was by the deterministic Stoics, in *εἱμαρμένη*, 'destiny'. This is the point of the statement in the myth that the one thing *not* specified in the 'patterns of lives' from which the souls have to make their selection is character (*Rep.* x. 617 e 3 *ἀρετὴ δ' ἀδέσποτον, ἣν τιμῶν καὶ ἀτιμάζων πλέον καὶ ἔλαττον αὐτῆς ἕκαστος ἕξει*).

T.'s determinist moral psychology is also rather glaringly inconsistent with itself. I hold, therefore, that it would be a bad mistake to attribute it to Plato. No doubt he might have admitted that there is 'something in it'. Physical defects may make us prone to irregular carnal appetite and ill temper, and considerable allowance has to be made on this score; the world's judgement on a good deal of a man's conduct is apt to be too indiscriminate. But the strongest Christian believer in the 'freedom of the will' and the strongest champion of unconditional obligation and absolute moral responsibility may perfectly well admit all this. There is nothing in it which involves accepting the 'determinism' which makes all moral choice the outcome of something which is not moral choice. Similarly the Socratic-Platonic doctrine *οὐδεὶς ἑκὼν ἁμαρτάνει* means simply that the man who chooses evil does not choose it *because* it is evil but *in spite* of that fact; he chooses it because *he* falsely takes it to be good. But there is no 'determinism' in such a statement. The doctrine only becomes 'determinism' if you add that the judgement is, in the end, made not *by* him but *for* him.

We are free, then, to hold that Plato's attitude towards his Pythagorean cosmologist is here, as elsewhere, marked by a certain detachment not untouched by a kindly irony. When we find T. falling into inconsistency we may suspect that his creator is intentionally making him 'give himself away'.

86 b 2–4. ***νόσον μὲν δὴ . . . ἀμαθίαν.*** Thus 'spiritual disease' in general is reduced by Timaeus to *ἄνοια* of which the two species are *μανία*, frantic madness, and *ἀμαθία*. Contrast with this the statement of the anonymous Eleatic, which we may fairly take for Plato's own, *Sophistes* 228 a–d, that we must distinguish, in the soul as in the body, between *νόσος* and *αἶσχος*, disease and mere disfigurement and (b 8) that the *νόσος* in the soul is *πονηρία*, the mere *αἶσχος* (d 4) *ἄνοια* or *ἄγνοια*, so that we get the result (d 6) *ἔστι δὴ δύο ταῦτα, ὡς φαίνεται, κακῶν ἐν αὐτῇ γένη, τὸ μὲν πονηρία καλούμενον ὑπὸ τῶν πολλῶν, νόσος αὐτῆς σαφέστατα ὄν . . . τὸ δέ γε ἄγνοιαν μὲν καλοῦσι, κακίαν δὲ αὐτὸ ἐν ψυχῇ μόνον γιγνόμενον οὐκ ἐθέλουσιν ὁμολογεῖν*. The practical consequence is that the *νόσος* has to be treated by punishment, the *αἶσχος* by instruction; *Sophistes* 228 e 6 *οὐκοῦν ἔν γε σώματι περὶ δύο παθήματε τούτω δύο τέχνα τινὲ ἐγενέσθην ;—τίνε τούτω ;—περὶ μὲν αἶσχος γυμναστική, περὶ δὲ νόσον ἰατρική. . . . οὐκοῦν καὶ περὶ μὲν ὕβριν καὶ ἀδικίαν καὶ δειλίαν ἡ κολαστικὴ πέφυκε τεχνῶν μάλιστα*

δὴ πασῶν προσήκουσα Δίκῃ ; . . . τί δέ ; περὶ σύμπασαν ἄγνοιαν μῶν ἄλλην τινὰ ἢ διδασκαλικὴν ὀρθότερον εἴποι τις ἄν ;—οὐδεμίαν. But T. has really left no place for πονηρία in his account of the 'diseases' of the soul; he confuses the surgery (ἰατρική) of the soul with its mere hygiene (γυμναστική). Real 'wickedness', πονηρία, is left out of account, as it always is by the 'determinist'. *Plato's* insight into the human heart goes infinitely deeper. Timaeus, in effect, conceives of no 'wickedness' which is more than weakness; the πονηρία of an Iago is beyond the range of *his* vision. The bad man, with him, is either a victim of μανία, uncontrollable excitement which makes him 'beside himself' for the time being, or of ἀμαθία, 'dullness', 'mental torpor'. He forgets the character called by Kant the 'cool calculating villain'.

Note also that T. is inconsistent with himself. Since he has all along laid the utmost stress on the soul's independence of and real distinction from the body, there is an obvious illogicality in the assumption he now goes on to make that it has no νόσοι of its own, but can only be affected by *bodily disorder.* (This is obviously the ultimate source of all moral evil with him, since the consequences of bad education must be explained by the badness of the educator, and this itself will have to be accounted for by the physical constitution either of the educator himself or of some one who perverted him. However many intermediate links you interpose, you cannot get away from the admission that a bad educational tradition must have been started by some one whose badness was due to congenital physical defect. The defect must be *physical*, since otherwise we should have to abandon the doctrine that God originally started all souls on the race of life 'at scratch' and without any handicapping, ἵνα μήτις ἐλαττοῖτο ὑπ' αὐτοῦ.) Socrates had argued in the opposite sense at the end of the *Republic*, where he made it a ground for asserting the deathlessness of the soul that it can only be destroyed, if at all, by its own special σύμφυτον κακόν and that this σύμφυτον κακόν is 'unrighteousness, profligacy, cowardice, and dullness' (*Rep.* x. 609 a ff.). The whole point of the argument there is that the body cannot directly produce 'disease' in the soul by infecting it; it can only do so indirectly by giving an occasion for the σύμφυτον κακόν of the soul to develop itself, in fact, in virtue of 'original sin'. This is fatal to the view T. is now maintaining. The point comes out most forcibly when we remember that T. subsequently says that women and animals are reincarnations of those men of the first generation who have lived more or less badly. Thus there is disease of the soul even in the first generation. This cannot be due to 'bad education', and on his principles, therefore, must be directly and entirely caused by physical defects. So he is at variance not only with the teaching of Socrates in *Rep.* x but with the express declaration of Plato (*Laws* x. 896 d 5) ὁμολογεῖν ἀναγκαῖον τῶν τε ἀγαθῶν αἰτίαν εἶναι ψυχὴν καὶ τῶν κακῶν καὶ καλῶν καὶ αἰσχρῶν δικαίων τε καὶ ἀδίκων καὶ πάντων τῶν ἐναντίων, εἴπερ τῶν πάντων γε αὐτὴν θήσομεν αἰτίαν.

86 c 3–d 5. τὸ δὲ σπέρμα . . . γέγονεν. These remarks are 'true so far as they go'. Some men are, from physical constitution, more sensible of the attractions of the various carnal pleasures than others, and allowance has to be made for this. It would be absurd to regard a man as admirable

for his continence if the real explanation of his regular life were merely that he was physically 'cold', and equally absurd not to recognize that a man of 'ardent' temperament may, in spite of his 'falls', be striving harder after purity than a 'colder' man whose life is more regular. But T. makes the grievous blunder of drawing no distinction between the man who masters his 'temperament' and the man who is mastered by it. He talks as though to have a strongly sensual temperament and to be a sensualist were the same thing. In point of fact this is false. Samuel Johnson's temperament seems to have been as 'ardent' as Robert Burns's.

86 c 4–5. ὅτῳ . . . γίγνεται καὶ . . . πεφυκὸς ᾖ. We must not 'correct' (i.e. corrupt) γίγνεται to γίγνηται. The mixture of indicative and subjunctive in these general relative clauses is natural and not very uncommon. See Stallbaum in loc. and C. W. p. 95 for illustrations from Thucydides, Isaeus, Demosthenes. Note the explicit contradiction of the Socratic and Platonic doctrine in the words *νοσοῦσαν καὶ ἄφρονα ἴσχων ὑπὸ τοῦ σώματος τὴν ψυχήν* (d 1–2).

86 d 4. διὰ τὴν ἑνὸς γένους ἕξιν. What the γένος is is explained in the following words ὑπὸ μανότητος ὀστῶν. It is 'one particular component' of the body, viz. τὸ ὀστοῦν. T.'s meaning is that the μυελός exudes through the bones of the spinal column if they are unduly porous. Thus he actually identifies ἀκολασία, moral 'incontinence' with 'incontinence' in the physician's sense of inability to retain a secretion until the normal time for its expulsion! The profligate is put on a level with the child who 'wets the bed'.[1]

86 d 6–7. καὶ σχεδὸν δὴ . . . ὀνειδίζεται. τῶν κακῶν depends on ἀκράτεια and ὄνειδος and the literal rendering would be 'what is spoken of as inability to master pleasure on the part of the bad and as a reproach to them, as though they were acting on set purpose, is erroneously made matter of reproach'. Here again T. does not express the thought of Socrates or Plato. They certainly hold that no one chooses evil, and therefore no one does wrong ἑκών, in the sense that no one chooses evil *because* he sees it to be evil, but *sub specie boni*, because he is deluded into taking it for good. But neither Socrates nor Plato ever says that we have no right to express moral disapproval of the 'lie in the soul', or that a man only chooses wrong from bodily infirmity or bad τροφή, and consequently οὐκ ὀρθῶς ὀνειδίζεται. Cf. for Plato's views on the point *Laws* xi. 926 d 5 τῷ δὲ ἡττηθέντι—the man whose case is decided to be a bad one—παρὰ τοῦ νομοθέτου ψόγος καὶ ὄνειδος κείσθω, πολλῶν χρημάτων νοῦν κεκτημένῳ ζημία βαρυτέρα, vi. 762 c 6 ὀνείδη τε ἐχέτω τὴν πολιτείαν ὡς προδιδοὺς τὸ ἑαυτοῦ μέρος and many another passage where ὄνειδος is recognized as the severest of all penalties which can be inflicted on a man of spirit. It would be absurd to direct the νομοθέτης to make constant use of this penalty, if Plato had himself held that the man who misbehaves cannot 'help him-

[1] ἓν γένος is a periphrasis for ἕν τι, 'one thing', 'one component'. The 'one component' is clearly neither the μυελός (A.-H.) nor one of the four 'roots', and I do not see what else it can be but τὸ ὀστοῦν. It is precisely to a defect (μανότης) in this γένος that the whole effect is ascribed. For the use of γένος in this sense cf. e.g. τὸ τῶν νεύρων καὶ τὸ τῆς σαρκὸς γένος, 74 b 3. The whole clause διὰ . . . ἕξιν is really superfluous, and merely gives additional emphasis to the statement that the cause of ἀκολασία περὶ τὰ ἀφροδίσια is a simple physical malformation.

self' and therefore does not really deserve the *ὀνείδη* he receives. The careful distinction kept up throughout *Laws* ix between voluntary and involuntary causing of *βλάβη*, 'hurt', 'damage' to another is of itself the best proof that Plato had no thought of quarrelling with the common-sense distinction between acts which are done 'on purpose' and acts which are not. For Socrates it is enough to refer to his description of himself, *Apology* 30 e 7 *ὃς ὑμᾶς ἐγείρων καὶ πείθων καὶ ὀνειδίζων ἕνα ἕκαστον οὐδὲν παύομαι τὴν ἡμέραν ὅλην πανταχοῦ προσκαθίζων* or his request (ib. 41 e 6) if his sons neglect virtue or *δοκῶσί τι εἶναι μηδὲν ὄντες, ὀνειδίζετε αὐτοῖς ὥσπερ ἐγὼ ὑμῖν ὅτι οὐκ ἐπιμελοῦνται ὧν δεῖ.*

86 e 2. *ἀπαίδευτον τροφήν.* The 'unskilful nurture' covers 'bad education', but the context suggests that T. is thinking in the first instance of a bad bodily regimen, a wrong *δίαιτα*, imposed by ignorant preceptors which makes the primary physical defect worse.

86 e 3. *καὶ ἄκοντι.* The only tolerable reading. According to St. it was originally proposed as a conjecture by Cornarius, but is now known to have the authority of F. The *κακόν τι* of A W Y arises from misdivision of the letters. The misdivision once made, a superfluous *καί* had to be inserted to make the sentence construable.

86 e 3—87 a 7. *καὶ πάλιν δὴ . . . δυσμαθίας.* Ill temper, arrogance, cowardice, and intellectual dullness are explained on the same principle as sensuality. The 'vapours' of *φλέγμα* and *χολή* which find no vent are supposed to spoil the temper and make a man moody if they collect in the region of the *ἐπιθυμητικόν*, to make him passionate, arrogant, or unduly timorous if they affect that of the *θυμοειδές*, dull and stupid if they invade the brain.

86 e 3. *τὸ περὶ τὰς λύπας = τὴν λύπην*, and is an internal accusative qualifying *πολλὴν ἴσχει κακίαν.* The accumulations are physically painful, and this is supposed to explain why the states of mind of the dis-spirited, or moody, or angry, or perplexed man are all disagreeably toned. The latent materialism of the passage should be noticed; it is quite out of keeping with the conception of *ψυχή* which dominated the metaphysical and cosmological part of the dialogue. This is dramatically right; no doubt the actual Pythagoreans were unconsciously more materialistic than they meant to be in their notions about *ψυχή*. Socrates rallies their pupils Cebes and Simmias on this very point, *Phaedo* 77 d 5, when he says that they seem to be afraid that the wind may blow the *ψυχή* to pieces on its departure from the body, especially if a gale happens to be blowing at the time.

87 a 5. *δυσκολίας καὶ δυσθυμίας.* The *δύσκολος* is the 'thrawn' or 'moody' man whom it is not easy to get on with, as his opposite, the *εὔκολος* is like the 'good, easy man', whose happy temperament makes every one at home with him. *δυσθυμία* is standing 'lowness of spirits', the habitual temper of a Mr. Despondency.

87 a 7–b 4. *πρὸς δὲ τούτοις . . . γιγνόμεθα.* The mischief is intensified when it is reinforced by bad systems of government and bad social traditions, and the neglect of the studies which might provide a remedy.

87 b 1–2. *λόγοι κατὰ πόλεις ἰδίᾳ τε καὶ δημοσίᾳ λεχθῶσιν.* The *δημοσίᾳ* would presumably include not only principles publicly avowed and acted on

by πολιτικοί and persons in authority, but maxims which are expressed in the poetical literature which speaks the general sense of the community; the ἰδίᾳ views which have not in this way got the stamp of the general approval. The two together make up the whole moral tradition in which a generation is educated. The contrast between the ποιητής and the ἰδιώτης occurs several times in the dialogues. Cf. *Phaedrus* 258 d 10 ἐν μέτρῳ ὡς ποιητὴς ἢ ἄνευ μέτρου ὡς ἰδιώτης, *Sympos.* 178 b 2 γοητὴς γὰρ Ἔρωτος οὔτ' εἰσὶν οὔτε λέγονται ὑπ' οὐδενὸς οὔτε ἰδιώτου οὔτε ποιητοῦ (=neither in prose nor in poetry). The poet is regularly recognized as a δημιουργός. In the same way we get the 'layman' in medicine contrasted with the 'professional', the ἰατρός, *Laws* xi. 933 d. Even the angler, as having a speciality, is distinguished from the 'amateur' (ἰδιώτης), *Sophistes* 221 c 8 καὶ μὴν ἐκεῖνό γ' ἦν τὸ ζήτημα πρῶτον, πότερον ἰδιώτην ἢ τινα τέχνην ἔχοντα θετέον εἶναι τὸν ἀσπαλιευτήν.

87 b 2–3. ἔτι δὲ μαθήματα . . . μανθάνηται. This again is a thoroughly Pythagorean touch. The μαθήματα are morally valuable, as the *Phaedo* explains, because they detach the mind from exclusive preoccupation with the insistent appetites of the body. (The Platonic doctrine, on the contrary, is that all ἐπιθυμίαι belong to the soul itself, *Philebus* 35 c 6 σώματος ἐπιθυμίαν οὔ φησιν ἡμῖν οὗτος ὁ λόγος γίγνεσθαι.) The stress T. lays on κακαὶ πολιτεῖαι must be brought into connexion with Socrates' statement that he had been an eminent πολιτικός himself in his time (20 a 4–5). This must have been in the days when the Pythagorean order had not yet lost its political power in the S. Italian cities. T. has himself borne his part in the 'rule of the saints' and naturally holds strong views about the consequences of government by 'malignants'.

87 b 4. δύο ἀκουσιώτατα. What are the two causes? One is clearly congenital lowness of bodily constitution. If we took only the immediately preceding words into account, we might suppose that the second was either κακαὶ πολιτεῖαι, or perhaps neglect of the μαθήματα. But from what follows it appears that it is rather bad τροφή, including under that head both wrong bodily regimen and a bad educational system.

87 b 4–6. ὧν αἰτιατέον . . . τῶν τρεφομένων. τοὺς φυτεύοντας, 'the begetters', refers to the first of the two assigned causes, congenital defects; these, T. thinks, are not our own fault but the fault of our parents who married unwisely or begot us οὐκ ἐν δέοντι; τοὺς τρέφοντας refers to, and enables us to identify, the second cause of evil, wrong τροφή. There is a lack of logic in T.'s 'determinism' of which we can hardly suppose Plato unconscious. The 'parents and fosterers' might fairly retort that their mistakes, by his own showing, are not their fault but the fault of *their* 'parents and fosterers', and these might make the same excuse. On a theory which holds that no one is really 'to blame' for anything it is nonsense to say that *A* is 'more to blame' than *B* for what *B* does. The *Republic* ends by teaching something quite different (οὐχ ὑμᾶς δαίμων λήξεται, ἀλλὰ ὑμεῖς δαίμονα αἱρήσεσθε, 617 e 1.) Proclus says neatly that the peculiarity of Plato's terminology is that he distinguishes between τὸ ἐφ' ἡμῖν, 'what is in our power', 'what we are free to do', and τὸ ἑκούσιον, giving the latter name only to what is good, because no one would wish for what is bad for him if he really understood that it is bad for him.

Hence when Plato says that the bad man acts ἄκων, he does not mean that the choice of evil is not ἐφ' ἡμῖν, 'a thing which depends on us', 'a thing for which we are answerable'; he only means that it arises from mistaking a bad thing for a good thing. Aristotle and mankind generally use τὸ ἑκούσιον and τὸ ἐφ' ἡμῖν as synonyms. Wrong choice is therefore really ἀκούσιον in Plato's sense of the word but really ἑκούσιον in Aristotle's sense. (*In Remp.* ed. Kroll ii. 355 πλὴν ὅτι κατ' αὐτὸν οὐκ ἔστι τὸ ἑκούσιον καὶ τὸ ἐφ' ἡμῖν ταὐτόν· ἀλλὰ τὸ μὲν ἑκούσιον ἐν μόνοις ἐστὶν τοῖς ἀγαθοῖς, εἴπερ ἀκούσιος καὶ ἀβούλητος ὁ τῶν κακῶν βίος· ἐφ' ἡμῖν δὲ καὶ ἀπὸ τῶν ἡμετέρων αἱρέσεων καὶ τὰ ἁμαρτήματα. καὶ γὰρ ταῦτα αἱρούμεθα καὶ ἑλόμενοι πράττομεν, ἀλλὰ δι' ἄγνοιαν. εἰ οὖν τὰ ἁμαρτήματα ἀκούσια μέν, ἐν ταῖς αἱρέσεσιν δὲ ἡμῶν ἐστι καὶ ταῦτα, πάντα μὲν τὰ ἑκούσια καὶ αἱρετὰ δήπουθέν ἐστι, οὐ πάντα δὲ τὰ αἱρετὰ ἑκούσια.)

87 b 7–8. φυγεῖν μὲν . . . ἑλεῖν. A plain allusion to the Orphic (?) formula (Demosth. *de Corona* 313) ἔφυγον κακόν, εὗρον ἄμεινον; 'Bane is fled; bliss is sped'.

87 b 8–9. τρόπος ἄλλος λόγων. T. pulls himself up short because he is diverging into a λόγος προτρεπτικός, in fact 'sermonizing'.

The whole of this section suggests a general observation. The line taken by T. in philosophy is an attempt to graft Empedocles on Pythagoras. Now the psychology of Empedocles was definitely what we should call 'materialistic'. He laid it down that 'we think with the blood round the heart', and that the character of our thoughts and feelings at any time depends on the proportion in which the four 'roots' are mingled in the body and particularly in the blood, where they are all mixed up together in minute parcels, exactly as T. has also said. (Fr. 105, R. P. 178 a αἵματος· ἐν πελάγεσσι τεθραμμένη ἀντιθορόντος, | τῇ τε νόημα μάλιστα κικλήσκεται ἀνθρώποισιν· | αἷμα γὰρ ἀνθρώποις περικάρδιόν ἐστι νόημα, Theophrastus, *de Sensu* 10 [*Doxogr. Graec.* 502 = R. P. 178] διὸ καὶ τῷ αἵματι μάλιστα φρονεῖν· ἐν τούτῳ γὰρ μάλιστα κεκρᾶσθαι [ἐστὶ] τὰ στοιχεῖα τῶν μερῶν, Fr. 106 *ap.* Aristot. *de Anima* Γ. 427ᵃ 21 ff. = R. P. 177 ὥσπερ καὶ Ἐμπεδοκλῆς εἴρηκε· "πρὸς παρεὸν γὰρ μῆτις ἀέξεται ἀνθρώποισιν", καὶ ἐν ἄλλοις "ὅθεν σφίσιν αἰεὶ | καὶ τὸ φρονεῖν ἀλλοῖα παρίσταται".) These ideas seem, indeed, to have been already growing up in Pythagorean circles as early as the time of Parmenides, for he represents the men of science criticized in the second part of his poem, who can hardly be any one but the Pythagoreans, as holding that 'thought comes to men as it finds the condition of their limbs, for a man's thought is that of which there is most in him' (Fr. 16 = R. P. 128 ὡς γὰρ ἑκάστοτ' ἔχει κρᾶσιν μελέων πολυπλάγκτων, | τὼς νόος ἀνθρώποισι παρίσταται· τὸ γὰρ αὐτὸ | ἔστιν ὅπερ φρονέει μελέων φύσις ἀνθρώποισιν | καὶ πᾶσιν καὶ παντί· τὸ γὰρ πλέον ἐστὶ νόημα.) This is a simply materialistic point of view; it makes our bodies the actual subjects which perceive and think, and leaves no room for such a ψυχή as T. has been describing in the earlier part of the dialogue. It was an error of principle to amalgamate this doctrine with the old Pythagorean belief in the unitary and immortal soul, and the error bore its fruits. In the *Phaedo* we find that Cebes and Simmias, who had been disciples of Philolaus, have come to believe that the ψυχή is just the ἁρμονία or κρᾶσις of the constituents of the body, and Socrates' chief difficulty in

persuading them of the immortality of the soul is that he has first to refute this doctrine. Echecrates is also a Pythagorean of Phlius—his name is in the list given by Iamblichus—and he, too, says that the doctrine had always greatly attracted him (*θαυμαστῶς γάρ μου ὁ λόγος οὗτος ἀντιλαμβάνεται καὶ νῦν καὶ ἀεί*, *Phd.* 88 d 3). Thus it is represented by Plato as the current theory of the youngest disciples of the Pythagoreans at the end of the fifth century, and we know that it was upheld by Aristotle's associate Aristoxenus of Tarentum, who had been intimate with the Pythagoreans of the fourth century. Timaeus retains the old beliefs in the incorporeal and immortal soul, as Socrates did, but his reduction of all moral defects to physical causes can hardly be anything but a consequence of the same influence of Empedoclean biology which led to the assertion that the soul is the *ἁρμονία* of the body. The doctrine of this section is, as we have seen, really quite inconsistent with all that we have been told about the *ψυχή* until we reach 86 b, but the inconsistency was bound to arise when two such incompatibles as Pythagorean religion and Empedoclean biology were flung together. Personally, no doubt, Timaeus and others went on sincerely holding as a religious faith views which their own biology contradicted, and the incoherence is rightly put by Plato into his picture. (See *EGPh.*[3] 295 and art. PYTHAGOREANISM in *ERE.*)

87 c 1—89 d 1. τὸ δὲ τούτων . . . ἐρεθιστέον. We pass now to general practical directions for remedial treatment of the defects we have considered, rules for the hygiene of body and soul. These may fairly be considered as a contribution to medicine and psychiatry, so that in giving them T. is not entering on *τρόπος ἄλλος λόγων*, the 'protreptic' or 'sermonizing', as he feared he would be if he had not cut the moralizing of 87 b short. In the main his rules of bodily and mental hygiene agree with those of Socrates in the *Republic*; they demand the same combination of *μουσική* with *γυμναστική*, with just that slight additional stress laid on care of the body that we should expect in a distinguished member of a medical school. But since the foundation of the whole treatment of *μουσική* and *γυμναστική* in the *Republic* is Pythagorean, Timaeus must not be supposed to be indebted to Socrates' recent report of his conversation with Glaucon and Adimantus; he is still speaking as a representative of the school to which he belongs.

87 c 3. δικαιότερον. Not as A.-H. takes it 'more appropriate to our theme', viz. the ordering of things for the best by God, but in a more general sense, 'it is right (*vaut mieux*, as M. translates) to 'let our minds dwell on good rather than on evil'. The reason is that the mind takes the impress of that which it contemplates. To dwell in contemplation on the 'seamy side' of things makes the mind itself baser.

87 c 4–6. πᾶν δὴ . . . θετέον. The connexion of thought is that the 'good' is always also the beautiful, and the beautiful is always the well-proportioned; disproportion is the secret of ugliness. But of all proportions the most important is that of a body to the mind whose vehicle and instrument it is, and of all disproportionateness the worst is disproportionateness between these two. The whole of our life ought therefore to be carefully regulated with a view to making the body an adequate instrument for the mind.

87 c 6–d 1. συμμετριῶν δὲ . . . ἀλογίστως ἔχομεν. The 'lesser *συμμετρίαι*' mean in particular the ratios which determine the melodic progressions of the *διὰ τεσσάρων, διὰ πέντε, διὰ πασῶν*, which were the discovery of Pythagoras. They are called 'lesser' chiefly, I take it, because they are so simple and can therefore be expressed by low numbers; the series 6, 8, 9, 12 gives them all. T. means that the proportions on which the right adjustment of body to mind depend could also be stated in numerical form, but they are less elementary, they would need a greater number of terms for their expression, and the terms would be much higher integers. Hence we have not succeeded in working the sum (*ἀλογίστως ἔχομεν*). The general point of view is the same as that of Socrates in the *Republic*, but Timaeus lays more stress than Socrates, who was speaking with a rather different purpose, on the purely 'hygienic' value of bodily regimen. Due proportion of soul to body is desirable (d 1–3) 'with a view to health and disease', for its hygienic effects, *no less than* 'with a view to virtue and vice', for its moral effects.

87 d 4–8. ὅτι ψυχὴν . . . ἐρασμιώτατον. T.'s thought is that proportion may be disturbed in either of two ways. The body may be too flourishing and vigorous for its mind—one thinks of the immortal Porthos—and then you get the robust stupid fellow with a great deal of superfluous carnality, the kind of man aimed at by the saying that excessive physical robustness is incompatible with spirituality, a truth exaggerated by Pascal when he declared that ill health is the most appropriate condition for a Christian. Or the soul may be too vehement and eager for the feeble body, the case described in Dryden's famous lines about Achitophel.

The whole *ζῷον*, the complex of body and mind, is not *καλόν* in either case; the disproportion between the mind and its body is too glaring. Porthos is amusing and Shaftesbury or William III may be impressive, but to the critical eye there is something wrong with both types. The value of daily care of one's diet, sleep, exercise (the recognized departments of *γυμναστική*), is that it minimizes this disproportion.

87 d 4–5. ἀσθενέστερον καὶ ἔλαττον εἶδος. The comparatives must not be rendered 'feebler', 'smaller', as though the 'greatness' or 'vigour' of a mind and a body could be expressed as magnitudes of the same kind; the meaning is the common one 'feebler', 'smaller' than ought to be the case, 'too feeble', 'too puny'. The use of *εἶδος* here is perhaps the best example in Plato of the employment of the word to denote quite definitely a 'body'. For further examples see my essay on the uses of *εἶδος* and *ἰδέα* in *Varia Socratica*.

87 e 1—88 b 5. οἷον οὖν . . . ἐναπεργάζονται. An argument *a fortiori*. If a disproportion between one part of the body and another has serious consequences (as it is assumed every one will admit), how much more serious must be the consequences of the *μεγίστη ἀμετρία*, disproportion of mind and body.

87 e 1. ὑπερσκελές. To have the legs too long for the trunk, or to have any similar want of physical proportion (*ὑπέρεξιν*, 'abnormal development' is internal accus. with *ἄμετρον ὄν*; for the implied sense of *ἕξις*, 'relation', cf. Euclid's definition of *λόγος*, ratio, as *δύο μεγεθῶν ὁμογενῶν ἡ κατὰ πηλικότητά ποια σχέσις*, *Elem.* v, def. 3), not only is *αἰσχρόν* ('un-

sightly') but causes fatigue (*κόπους*), awkwardness (*σπάσματα*), and accidents (*πτώματα*) *διὰ τὴν παραφορότητα*, because it (the undue length of the man's legs) makes the man 'sprawl', and so is positively injurious. Of course, then, disproportion between mind and body will be much more seriously injurious than such a thing as disproportionate length of leg.

87 e 6—88 a 7. *ὡς ὅταν . . . ποιεῖ.* T. first considers the precise case of Dryden's Achitophel. A soul too fiery for its body (*περιθύμως*, 88 a 1) actually 'frets' (*διασείουσα*) the body into disease, or wears it out (*κατατήκει*) by excessive application to study (the case of Browning's Grammarian), or again overheats it and causes dangerous chills (*ῥεύματα ἐπάγουσα*) in the excitement of argument and controversy. As to *δημοσίᾳ καὶ ἰδίᾳ* (a 4), the first case contemplated is pretty clearly that of a *πολιτικός* who catches his death by overheating himself in debate; he makes a great speech, but the effort kills him. The *ἰδίᾳ* plainly refers to eager and vehement *ἔριδες* carried on in the philosophical schools. We must remember that Timaeus is a contemporary of Zeno.

88 a 5. *σαλεύει.* The overwhelming MS. authority is in favour of the variant *λύει*, but *σαλεύει* must be right for (1) *λύει* is much too strong a word. One is not usually brought to 'dissolution' by getting overheated in a scientific argument. Legend, indeed, ascribes the death of Malebranche to a chill brought on by such an argument with Berkeley, but Malebranche was already an infirm old gentleman of eighty. And (2) the source of corruption is obvious; it is the mere omission of the ΣΑ of *σαλεύει* after the ΣΑ of *ποιοῦσα*. The *φιλόνικος* or *φιλότιμος* is only the second-best type of man, hence the introduction of the *καὶ φιλονικίας* is an urbane criticism by a Pythagorean on the Eleatic critics of his own companions. It is hinted that Zeno and his imitators 'talked for victory' and so were not quite entitled to reckon as *φιλόσοφοι*. Zeno himself is made to admit that the charge was not without foundation and to plead youth as an excuse at *Parmenid.* 128 d 6 *διὰ τοιαύτην δὴ φιλονικίαν ὑπὸ νέου ὄντος ἐμοῦ ἐγράφη, καί τις αὐτὸ ἔκλεψε γραφέν.*

88 a 6–7. *τῶν λεγομένων . . . ποιεῖ.* The average practitioner 'lays the fault on the guiltless', i. e. he lays the blame for the chill which proves fatal on his patient's body, whereas he should lay it on his undue and unphilosophical 'heat' of mind or temper. This must be the meaning, and for this reason the reading of F W in a 7 *τὰ ἀναίτια* should be preferred to *τἀναντία* of A and Y, and apparently all editors before Bt. Soul and body are not *ἐναντία*, like *θερμόν* and *ψυχρόν*, or *λευκόν* and *μέλαν*. 'Opposites', Aristotle says, are *τά τε μὴ δυνατὰ ἅμα τῷ αὐτῷ παρεῖναι τῶν διαφερόντων κατὰ γένος, καὶ τὰ πλεῖστον διαφέροντα τῶν ἐν τῷ αὐτῷ γένει . . . καὶ τὰ πλεῖστον διαφέροντα τῶν ὑπὸ τὴν αὐτὴν δύναμιν, καὶ ὧν ἡ διαφορὰ μεγίστη ἢ ἁπλῶς ἢ κατὰ γένος ἢ κατ' εἶδος* (*Met.* Δ. 1018[a] 25–31). The only one of these senses which fits the case of soul and body is the last, but it will be noted that where Plato is concerned to prove that the *διαφορά* of soul and body is *μεγίστη* (as at *Phd.* 79 a—80 a), he never calls soul and body *ἐναντία*. His language always conforms to the principle laid down by Aristotle that there is no *ἐναντιότης* between terms which fall under the category of *οὐσία* (*Cat.* 3[b] 24 *ὑπάρχει δὲ ταῖς οὐσίαις καὶ τὸ μηδὲν αὐταῖς ἐναντίον εἶναι*), and both *σῶμα* and *ψυχή* on his view belong to this cate-

gory. τἀναντία ought therefore to have been seen from the first to be a corruption, and the reading ἀναίτια enables us to restore with confidence just the sense we need.

88 a 7–8. σῶμά τε . . . γένηται. This is the second case of the great and lusty body with no mind to speak of. Note the use of ὑπέρψυχον in the sense of 'too great for its soul', 'being beyond its soul'. For this sense of ὑπέρ in compounds cf. Plato's own words ὑπερουράνιος (*Phaedrus* 247 c 3), 'beyond the οὐρανός', ὑπέρμετρος *Laws* ix. 864 d 4 γήρᾳ ὑπερμέτρῳ συνεχόμενος, and the imitations of these formations by the later Platonists, such as ὑπερούσιος. All these formations are strictly parallel. The supreme evil, in this case, is that there are two hungers, that of the body for food and that of the soul (the 'divine in us') for its 'bread from heaven' wisdom, and when the body is huge out of proportion, its appetites get all the satisfaction and the soul is starved, and so grows 'deaf and dull'. One's time is so much taken up with eating that none is left in which to learn and think.

88 b 5–c 1. μία δὴ σωτηρία . . . ὑγιῆ. The ideal, then, is that mind and body should be 'in equipoise' (ἰσορρόπω), should balance one another. Then, on the theory that health is ἰσονομίη, you will secure the health of body and mind at once, the health of the whole man. The stress laid on ὑγίεια is historically right in the mouth of a Pythagorean, since the conception of the *mens sana in corpore sano* goes back to them. Compare the well-known stories that they used ὑγίαινε, instead of the customary χαῖρε, as a greeting in their letters (as Plato uses εὖ πράττειν in his), and that they engraved their seal-rings with the 'star-pentagon' or 'pentacle' as a symbol of ὑγίεια. ἀμυνομένω, b 7, means no more than *vicissim* and goes closely with γίγνησθον ἰσορρόπω, 'that each may be equipoised against the other', or, as A.-H. happily turns it, 'that they may be a match' for one another.

88 c 1–d 1. τὸν δὴ μαθηματικὸν . . . εἶδος. Hence the necessity for the sedentary student to keep his body fit by γυμναστική and for the man who leads a physically active life to cultivate his mind, if the desired equipoise is to be attained. This involves the combination of μουσική with γυμναστική advocated by Socrates in the *Republic*, but the point of view is rather different. Both S. and T. dwell on the point that exclusive devotion to either way of life produces only a 'half man', but Socrates is further moved by ethical considerations, of which T. says little, and political considerations, of which he says nothing at all; T. is primarily concerned with psycho-physical hygiene and its rationale, and he has not in mind the importance of creating an army which shall be at once devotedly loyal and professionally skilled.

88 c 1. μαθηματικόν. Observe that T., as a Pythagorean, assumes that mathematics, τὰ μαθήματα, are the supreme intellectual occupation. Plato would have said διαλεκτική, the science which reveals 'the one in the many and the many in the one', if he had been speaking from his own point of view. But to Timaeus 'dialectic' would mean, if anything, the characteristic method of Zeno and the Eleatics which he has already disparaged in 88 by the contrast between μαθήσεις καὶ ζητήσεις and μάχαι δι' ἐρίδων. That Plato ever abandoned the claims made in the *Republic* for 'dialectic'

is a mere *fable convenue*. Every member of the Supreme Council of State in the *Laws* is expressly required πρὸς τὸ ἓν ἐπείγεσθαι γνῶναί τε, καὶ γνόιτα πρὸς ἐκεῖνο συντάξασθαι πάντα συνορῶντα, and we are told that there is no ἀκριβεστέρα σκέψις θέα τε περὶ ὁτουοῦν ὁτῳοῦν ἢ τὸ πρὸς μίαν ἰδέαν ἐκ τῶν πολλῶν καὶ ἀνομοίων δυνατὸν εἶναι βλέπειν (*Laws* xii. 965 b 9–c 3). This means that the rulers in the *Laws*, no less than in the *Republic*, are to be διαλεκτικοί. In a 2 διανοίᾳ is simply 'with his mind', διάνοια being perhaps the commonest ordinary Attic prose word for 'mind', when the older Ionic word γνώμη had gone out of fashion. The distinction drawn by Socrates in *Rep.* vi between διάνοια and νόησις is peculiar to that passage and later commentaries directly inspired by it.

88 c 3–4. τόν τε αὖ σῶμα ἐπιμελῶς πλάττοντα. This is the counterpart to the case of the sedentary student. A man who is 'carefully moulding his body' must keep his mind from inertia by giving attention to 'music and φιλοσοφία in general'. This, too, is Pythagorean, if the statement that 'philosophy is the highest music' quoted at *Phd.* 61 a 3 is Pythagorean, as it seems to be. (See Bt. n. in loc., *EGPh.*[3] 97–9.) The conclusion of the sentence seems to show that T. is using the word φιλοσοφία as it is used in the *Phaedo* for the redemption of the soul from the vices it has contracted while in the body, not in the Platonic sense in which thorough search for first principles of any kind is φιλοσοφία. (See art. PYTHAGOREANISM in *ERE.*)

For the meaning of σῶμα πλάττειν, 'to mould the body' by regimen and exercise, cf. *Rep.* ii. 377 c 2 τοὺς δ' ἐγκριθέντας πείσομεν τὰς τροφούς τε καὶ μητέρας λέγειν τοῖς παισίν, καὶ πλάττειν τὰς ψυχὰς αὐτῶν τοῖς μύθοις πολὺ μᾶλλον ἢ τὰ σώματα ταῖς χερσίν, where the reference is to 'massage'. There is another instance, as I believe, of the same expression at *Phd.* 82 d 3 ἐκεῖνοι οἷς τι μέλει τῆς ἑαυτῶν ψυχῆς ἀλλὰ μὴ σώματι (so B, σώματα B^2 T W) πλάττοντες ζῶσι. Bt. here writes σώματι, a reading which compels us to take σώματι with ζῶσι, 'live for the body', a harsh and unusual phrase. I believe we should read σώματα with T W. The philosopher is being contrasted with the *athlete* who lives σῶμα πλάττειν to make his body fit. The philosopher is a '*spiritual* athlete'.

88 c 6. κεκλῆσθαι. Most editors substitute κεκλήσεσθαι restored from one inferior MS. by Bekker. The change should *not* be made, since μέλλω followed by a present infinitive is just as good Attic as μέλλω followed by a future, and in meaning κεκλῆσθαι here has the force of a present, 'to bear the name of', like τεθνάναι, 'to die'. In *Apology* 30 c 1 we have from Plato himself οὐδ' εἰ μέλλω πολλάκας τεθνάναι, 'not though I should risk dying many times over', an exact parallel with μέλλω κεκλῆσθαι.

88 c 7–8. τὸ τοῦ παντὸς . . . εἶδος. 'In imitation of the *body* of the *universe*.' The meaning is explained immediately to be that by proper exercise of the different μέρη of our bodies we assist the human body to keep up that combination of unlikes within it which, as we have already been told, is effected by the vibration of the ὑποδοχή and counteracts the tendency of the 'roots' in the great κόσμος to be sorted out into four homogeneous aggregates. The parallel is a piece of pure Empedocleanism.

88 d 1–4. τοῦ γὰρ σώματος . . . τῶν κινήσεων. The sentence is so worded that the effects of the various agents, internal and external, on the body are made to correspond to the four 'opposites' which play the most prominent part in the earliest cosmologies, *θερμόν*, *ψυχρόν*, *ξηρόν*, *ὑγρόν*. The distribution of these 'opposites' between the internal agents and the external suggests that here, at any rate, the air (which enters the body in respiration) is identified with *τὸ ψυχρόν*, and that earth and water are the *ξηρόν* and *ὑγρόν*. *διώλετο* must be taken as a 'timeless', not as a 'momentary' aorist, 'he is (regularly) destroyed', since it is not true that cessation from exercise and passive surrender to the action of the 'elements' brings *sudden* death in its train.

88 d 6. τροφὸν καὶ τιθήνην. There is a playful point in recalling the epithets of the universal *ὑποδοχή*. Nurses notoriously keep shaking their charges up and down and dandling them by way of keeping their bodies right, and the vibration of the *ὑποδοχή*, the *τιθήνη γενέσεως*, is playfully likened to this dandling. Cf. *Laws* 790 c 5, where Plato commends the practice and says that infants ought never to be left quite still; they should spend day and night as though they were always at sea, 'rocked in the cradle of the deep'. T. would have adults reach the same result by appropriate physical exercises.

88 e 1. ἀμύνηται. Again the word means 'balances', 'compensates' (lit. 'counters') the movements to which he is passively subjected by compensatory voluntary movements of his own. But for the vibrations of the *ὑποδοχή* the frame of things would disjoint. The same thing would happen in the *μικρὸς κόσμος* of a man who took no exercise and followed no regimen.

88 e 3. κατὰ συγγενείας. St., M., A.-H. connect the words with *εἰς τάξιν κατακοσμῇ*, taking them to mean 'according to their affinities'. But surely, in the mouth of T., who had never heard of 'chemical affinities', particles of fire are *συγγενῆ* only with particles of fire, and so on. Thus we shall get the very opposite of the sense required. The object of the *γυμνασία* is precisely to *prevent* this sorting of 'like to like' and to keep *unlikes* together. It seems to me that the position of the words is due to 'hyperbaton' and that they go with *πλανώμενα*, the sense being that we are to bring into ordered relations with one another the *παθήματα* and *μέρη* which 'are wandering over the body according to their affinities' for their *own* kind.

88 e 4—89 a 1. οὐκ ἐχθρὸν . . . παρέξει. The words are meant to recall Empedocles' name for the movement of unlike 'roots' towards one another, which, when it prevails, reduces the *κόσμος* to a single compact mass, *φιλία* or *φιλότης*. T. is as good as telling us that his conception of the life of the 'greater' and the 'lesser' worlds as alike dependent on a pair of opposite and compensating tendencies comes to him from Empedocles. If he had meant to speak of anything like 'chemical affinity' of one element for another at e 3 above, it is hard to say what word he would have found available for it but *φιλία*, and here, where he is speaking of the combinations of unlikes, he does express the idea by the words *φιλον παρὰ φίλον*. This seems to me in favour of the view I have taken of the construction of the clause *τά τε περὶ τὸ σῶμα . . . πρὸς ἄλληλα*.

89 a 1–d 1. τῶν δ' αὖ κινήσεων . . . ἐρεθιστέον. *Remarks on the principles of bodily hygiene.* There are three ways of producing the right kind of motions in the body, (1) active γυμνασία, (2) passive γυμνασία by voyaging in boats, riding in carriages, and the like (cf. the now antiquated phrase 'to take carriage exercise'). This, too, shakes up the contents of the body and produces the right and healthful kinds of internal motion. (3) The violent purgation of the body by drugs of various kinds which clear it of its morbid accumulations. The last is only to be adopted in cases of urgent necessity. As a general rule, one should avoid drugs, follow sound rules of hygiene, and leave minor disorders to the *vis medicatrix naturae*. This is in full accord with the theory and practice of the best fifth-century medicine which relied mainly on δίαιτα, proper regulation of food, exercise and sleep, and little on drugs. It is also what Socrates has in mind in *Republic* iii, when he denounces the valetudinarian and expresses a preference for the working-man who has no leisure to pursue a lengthy 'cure', and only goes to the doctor for a prescription when he absolutely must. Socrates indulges in a comic passion of sham fury against the *malade imaginaire* which has oddly been decried as heartless by the majority of critics, but he means neither more nor less than what Timaeus says here. Active exercise is best, because in it a man is moving *himself*, and imitating most nearly the behaviour of the ψυχή and the οὐρανός. Purgatives (and this means *all* 'doctor's stuff', since all drugs are intended to clear the system of something) are worst of all, because the body as a whole is not being exercised; only certain parts are moved and they are moved in an *unnatural* way.

89 a 4. κειμένου τοῦ σώματος. What T. dislikes is that a man should just lie in bed, swallow an emetic or the like, and wait for it to act.

89 a 6. συστάσεων. The word is used here to denote the process antithetical to κάθαρσις. κάθαρσις removes the unwholesome and superfluous, σύστασις brings firmly and compactly together constituents which ought to be united. The one is a liquefaction, the other a solidification. Hence L. and S. s. v. σύστασις should have given the reference to this passage under B. ii. 4, not under A. 1. Ast, quoting the words *s. voc.* in his *Lexicon Platonicum*, rightly renders συστάσεων by *restitutionum*. An exactly similar phrase is *Laws* vi. 782 a 5 πόλεων συστάσεις καὶ φθοράς, 'consolidations and dissolutions of cities', i. e. 'the rise and fall of states', and not very dissimilar are σύστασις νόσων and τῆς περὶ τὰ νοσήματα συστάσεως, 'morbid formations' in b 5, c 4–5 *infra*. Tr. 'of all ways of purging and reforming the body'.

89 a 7. ἡ διὰ τῶν αἰωρήσεων. This does not refer to exercise in a swing, but, as M. saw, to the oscillatory motion you get if you take a drive or go on the water in a boat. The τε after κατά belongs to the following καί and is only separated from it by the common 'hyperbaton'. Tr. 'the vibratory motion of a sailing ship or any other kind of conveyance in a vehicle which is not fatiguing'. Any up-and-down motion is an αἰώρησις. See Bt.'s note on *Phd.* 111 e 4.

89 b 1. σφόδρα ποτὲ ἀναγκαζομένῳ. That is, T. would admit the value of a purgative in an attack of severe constipation, or of an emetic when one has taken a dangerous substance into the body, or in attacks of an 'acute'

disorder. But they should not be used without such special necessity. We see from numerous allusions in the Hippocratean corpus that the Greeks of the fifth century were accustomed to ' purge themselves ' by violent emetics and aperients periodically as a hygienic precaution. T.'s objection to the practice has its parallels in the Hippocratic writings. Thus the *περὶ διαίτης ὑγιεινῆς* warns its readers against too free a use of these methods, though the author, unlike T., believes in a sparing employment of them as a prophylactic. Kühn i. 619 *τοῖσι δὲ ἐμέτοισι χρὴ καὶ τοῖσι κατακλύσμασι τοῖσι τῆς κοιλίης* (*lavements*) *ὧδε χρέεσθαι. ἓξ μῆνας τοὺς χειμερινοὺς ἐμέειν. . . . ὅταν δ' ἢ θάλπος, τοῖσι κατακλύσμασι χρέεσθαι* (the reason being that we want to get rid of *φλέγμα* in the winter, but of *χολή* in the hot weather). Directions are then given for the making of both emetics and *lavements* and the preparations for using them, according to the peculiarity of the individual's constitution, and special regulations for the cases of women and children. The tract is meant, in fact, to be used by an intelligent man for the regulation of his own health. From the expression (i. 621) *ὅστις δὲ εἴωθε τοῦ μηνὸς δὶς ἐξεμέειν* we see that there was reason in complaining of the abuse of such practices as Timaeus and Socrates both do. Their contemporaries pretty clearly ' physicked themselves ' too much, and this explains S.'s pretended impatience with such practices in *Rep.* iii. In *περὶ διαίτης* $\bar{\gamma}$ (Kühn i. 710) the reader is recommended to use emetics two or even three times a month throughout the winter and to employ three days in getting back to his regular diet (the *σύστασις* after the *κάθαρσις*). Since at i. 708 the writer has explained that his rules are intended for the benefit of ordinary men with daily work to do, Socrates' proposal to take the working-man as the standard in this matter is by no means so ' Spartan ' as it seems. S. is assuming the existence of such manuals for self-treatment as *περὶ διαίτης ὑγιεινῆς* and *περὶ διαίτης* $\bar{\gamma}$. T. objects to even a moderate employment of emetics and purges as a regular practice.

89 b 3–4. *ὅσα μὴ μεγάλους ἔχει κινδύνους.* This is inserted to permit of forcing nature's hand in the case of a really dangerous ' acute ' disease.

89 b 4–d 1. *πᾶσα γὰρ σύστασις . . . ἐρεθιστέον.* Just as the ' triangles ' in an animal's body are constituted to hold out against wear and tear for a certain time and no longer, so that, apart from accidents, the average duration of life is fixed for each species, and the length of an individual's life is similarly fixed by his constitution, so a disease runs through a certain natural period and ends by working itself out of the system. It is dangerous to interfere with this natural period by employing violent medicines to hasten or retard it, and the thing should only be done in cases of downright necessity. In general we should trust to *δίαιτα*, intelligent regulation of exercise, food, sleep, temperature, air, and not to the operation of powerful drugs, a point of view to which medicine has happily come back again. It is useful to compare with this passage the tone and method of such works as the Hippocratean *προγνωστικά* and *περὶ διαίτης ὀξέων*.

89 b 7. *τοῦ τε γένους σύμπαντος.* This might conceivably mean what A.-H. takes it to mean, that ' species ' last for a time and then disappear. As for his question about the cause of this disappearance of whole species, one might recall what is said in the famous passage of the *Republic* viii.

546. If it were clear that T. is alluding to the disappearance of species at all, we might find the cause in the begetting of offspring *οὐκ ἐν δέοντι*. I believe, however, that he is not thinking of anything of the kind. There is no suggestion of the perishability of *species*, an idea not so familiar to the Greek mind as it is to ours. What is meant is that there is a fixed *average* length of life for the *individuals* of each species, and there is also the further fact that the probable longevity of a *given* individual—his 'expectation' of life—depends on congenital constitution. (So correctly Fraccaroli.) T. only means that the individuals of some species live, on the average, longer than others. Dogs are in old age at fourteen, men are not, and men are old at eighty, giant tortoises are not. *Why* the 'triangles' in a man hold out longer than those in a dog, and those in a great tortoise longer than those in a man is just the sort of thing we cannot explain. We do not see why it is 'best' that some lower animals should live longer than ourselves; we have to accept the brute fact, and it is an example of what was meant by calling the world the work of God *and ἀνάγκη*. Late writers assert that the Pythagoreans saw some deep significance in the fact that 70, the product of the *ἑπτάς* and the *δεκάς*, is the 'natural term' of man's years. (Cf. Macrobius *in Somnium Scipionis* I. vi. 62–4, Proclus *in Alcibiadem I*, Creuzer, p. 196.) The notion was pre-Pythagorean, since we find it in the well-known lines of Solon on the successive 'ages' of life (Hiller-Crusius, Solon Fr. 27), but we may feel sure that the school would from the first accept a doctrine which would appear so striking a confirmation of their views about the biological importance of numbers. Hence it is probable that it is this fancy that a human life is a decade of 'weeks of years' which T. has in his mind.

89 c 3. **οὗ βίον** A W P Y, **οὗ βίου** F. With the better attested reading *βίον* is internal accus. with *βιώῃ ἄν*, with the other *βίου* has to be taken as depending on *εἰς τὸ πέραν*. The former construction seems to me the more Platonic.

89 c 5. **παρὰ τὴν εἱμαρμένην.** *εἱμαρμένην* is adjectival; supply *περίοδον* or *μοῖραν*. If you administer a drug too early or too late, not at the opportune moment, you 'spoil' things, and the chance is that what would have been a light ailment may be turned into a serious one. Careful directions about choosing the right time (*καιρός*) for the application of remedies are laid down, e.g. in Hippoc. *περὶ διαίτης ὀξέων*. Cf. op. cit. 20 (Kühlewein i. 118) *καιρὸν δὲ τῆς δόσιος τοῦ ῥυφήματος τόνδε μάλιστα φυλάσσεσθαι κατ' ἀρχὰς καὶ διὰ παντὸς τοῦ νοσήματος . . . καὶ νομίζειν μέγα δύνασθαι τὸν καιρὸν τοῦτον ἐν πάσῃσι τῇσι νούσοισιν, οὐχ ἥκιστα δὲ ἐν τῇσιν ὀξείῃσιν. μάλιστα δ' ἐν τῇσι μᾶλλον πυρετώδεσιν.* The same work is full of illustrations of the principle T. goes on to lay down that diseases should be treated by *παιδαγωγία*, 'gradual', not by sudden and violent methods. They must be 'humoured, not drove'. The standing epithet for this gradual treatment in the Hippocratean writings is *ἐκ προσαγωγῆς*.

89 c 8. **καθ' ὅσον ἂν ᾖ τῳ σχολή.** A qualification of the rule. Your procedure should be as gradual as the case will allow. The *τίς* is the patient. If you are treating an artisan, a tradesman, an active politician, your patient will not have unlimited *σχολή* to expend on his cure, as Socrates says in the *Republic*, and you must 'cut your coat according to your cloth'.

89 d 1. κακὸν δύσκολον, a 'stubborn' complaint.

Pythagorean origin of the theory of the combination of 'gymnastic' and music.

There can be no doubt that the Pythagorean society was interested from the first in medicine. We should expect this from the mere fact that its first home was Crotona where, as we learn from the tales in Herodotus about Democedes, the Greek physician of Darius, there was already a medical school of high repute. Alcmaeon, the most eminent man of the school, is said by Aristotle (*Met.* A. 986[a] 29) to have been a young man in the old age of Pythagoras, and he dedicated his book (D. L. viii. 83) to Brontinus, Leon, and Bathyllus. Brontinus (or Brotinus) and Leon are both included in the catalogue preserved in Iamblichus's *Life of Pythagoras* (*V. P.* 267) as Pythagoreans from Metapontium, and a certain Bathylaus of Posidonia, who may well be D. L.'s Bathyllus, is also mentioned. Theano, wife of Brontinus, is also named among the Pythagorean ladies. Iamblichus has preserved a mass of stories, which appear to come from the works of Aristoxenus about the Pythagorean 'life' and 'doctrines' (ἀποφάσεις). Most of the matter will be found conveniently excerpted in *Fr. d. Vors.*[8] i. 361–72. According to this account 'the Pythagoreans honoured among the sciences not least music and medicine and divination . . . In medicine they paid most attention to the branch which treats of regimen (τὸ διαιτητικὸν εἶδος), and were exceedingly accurate in this part of the subject. First they tried to discover indications of the proper proportion of food, drink, and sleep (σημεῖα συμμετρίας ποτῶν τε καὶ σιτίων καὶ ἀναπαύσεως). Next they were about the first to attempt investigation and prescriptions about the actual preparation of viands (περὶ αὐτῆς τῆς κατασκευῆς τῶν προσφερομένων). They also paid more attention to cataplasms than their precursors, but gave less approval to drugs (τὰ δὲ περὶ τὰς φαρμακείας ἧττον δοκιμάζειν), . . . and least of all to surgery and cautery. They even used charms (ταῖς ἐπῳδαῖς) against some indispositions. Further they held that music greatly promotes health if employed in the proper way (καὶ τὴν μουσικὴν μεγάλα συμβάλλεσθαι πρὸς ὑγείαν, ἄν τις αὐτῇ χρῆται κατὰ τοὺς προσήκοντας τρόπους). And they used selected passages of Homer and Hesiod as restoratives for the soul (πρὸς ἐπανόρθωσιν ψυχῶν)' (*V. P.* 163–4). Iamblichus tells us that it was a Pythagorean rule, after their morning studies, to 'pay attention to their bodies. Most of them engaged in anointings and races, fewer also in wrestling, and some moreover in swinging dumb-bells (ἁλτηροβολίᾳ) and exercises for the arms (χειρονομίᾳ)' (ib. 97). Pythagoras is even represented in the late *Lives* as having trained competitors for the great games, but as the story was that he made a new departure by training them on beef instead of a vegetable diet, we are probably dealing here with a distortion of truth by Aristoxenus, who was anxious to cover up what he thought 'superstitious' in Pythagoreanism. (See Art. PYTHAGOREANISM in *ERE.*) Still, when all allowances have been made for the 'tendencious' misrepresentations of Aristoxenus, we cannot reasonably doubt that the general account of the attention given by the school to hygiene and the way in which they combined music with the διαιτητικὸν εἶδος of medicine to produce a sound mind in a sound body is historical. The remark quoted by an anonymous

writer from Aristoxenus that *οἱ Πυθαγορικοὶ καθάρσει ἐχρῶντο τοῦ μὲν σώματος διὰ τῆς ἰατρικῆς, τῆς δὲ ψυχῆς διὰ τῆς μουσικῆς* (*Fr. d. Vors.*[5] i. 362) does not do them full justice, since the *μουσική* was supposed to act on the body as well as on the soul. Timaeus, then, is in strict agreement with the known principles of his school, and Socrates' combination of *μουσική* and *γυμναστική* as well as his disapproval of constant recourse to the physician and his drugs in the *Republic* clearly come from the same source.

89 d 2—90 d 7. καὶ περὶ μὲν . . . τὸν ἔπειτα χρόνον. *Hygiene of the Soul.* This is merely sketched in the barest outline, because to treat it properly and accurately (*δι' ἀκριβείας*) would require a separate substantial discourse. (It is the main subject of Plato's longest *λόγος*, the *Laws*.) In a work on cosmology, moral hygiene can only be mentioned briefly in a digression (*ἐν παρέργῳ*). The main thing is that none of the three parts of the soul must be left to stagnate in inaction, and that their motions must be duly proportioned to one another, which means that the sovereignty must always be with that 'divine' part in virtue of which we are 'like God'. We give this part its 'proper motions' by correcting the disturbance of the 'circles in the head' produced by birth, so that they once more correspond with the circles in the great *οὐρανός* and we hear the celestial music, and become ourselves like what we hear. What mode of life will produce this result T. does not say; that had, in fact, been the subject of the discourse he is supposed to have heard from Socrates (the *Republic*), and does not belong to his own special topic, cosmology.

89 d 4. ὑφ' αὑτοῦ. This is, no doubt, the correct text and yields a proper sense. St.'s proposed emendation *ὑπ' αὐτοῦ*, however, deserves neither the denunciation of A.-H. nor the admiration of Fraccaroli. It yields a possible sense, but it is an unmotived change and therefore not to be accepted. With the MS. text we understand *αὐτόν* with *διαπαιδαγωγῶν*, how a man should live 'guiding and being guided by himself'. St.'s proposal gives the sense 'guiding (his body) and being guided by it'. Since a man following a regimen of mind and body would sometimes need to adapt his mental pursuits to the state of his body (e. g. not to undertake hard mental work when down with influenza), there is no absurdity in such a phrase. (St. explains that he supposes the text with his correction to refer to what T. had said about letting a disorder run its natural course.) It is more natural to understand the 'guiding' to refer to the part played by the mind in 'giving the rule', the *διαπαιδαγωγούμενος* to the part played by *both* body and mind in obeying it. T.'s real object in using the phrase is to lay stress on the point that the true regulation for both body and mind is self-regulation, not control by a physician or a 'spiritual director'. To understand the active participle of the soul and the passive of the body would be to miss a great part of his point. Strictly speaking the *διαπαιδαγωγῶν* would be, in T.'s terminology, the 'divine part' of the soul; the 'mortal parts', no less than the body, are comprehended in the *διαπαιδαγωγούμενος*. Even in the case of which St. is thinking, that of a man who lets a malady work itself out—it is the *mind*, and more precisely its 'divine part', which performs an act of *παιδαγωγία*.

89 e 5. τυγχάνει δὲ ἕκαστον κινήσεις ἔχον. For the *κινήσεις* of all three 'parts' cf. *Laws* x. 896 e 8 *ἄγει μὲν δὴ ψυχὴ πάντα τὰ κατ' οὐρανὸν*

καὶ γῆν καὶ θάλατταν ταῖς αὐτῆς κινήσεσιν, αἷς ὀνόματά ἐστιν βούλεσθαι, σκοπεῖσθαι, ἐπιμελεῖσθαι, βουλεύεσθαι, δοξάζειν ὀρθῶς ἐψευσμένως, χαίρουσαν λυπουμένην, θαρροῦσαν φοβουμένην, μισοῦσαν στέργουσαν, κτλ. Here *σκοπεῖσθαι, ἐπιμελεῖσθαι, δοξάζειν, βουλεύεσθαι* are activities belonging to what in the 'tripartite' psychology is called the *λογιστικόν*, *λύπη* and *χαρά* belong to the *ἐπιθυμητικόν*, *θάρρος* and *φόβος* to the *θυμοειδές*. The division is not mentioned in the *Laws* because it is no part of Plato's own psychology.

90 a 3–4. αὐτὸ δαίμονα θεὸς ἑκάστῳ δέδωκεν. That is, the 'luck' or 'guardian angel' of each of us is just his *λογιστικόν* or *anima rationalis*. The notion of guardian spirits comes from theogonies of remote antiquity. Hesiod says (*Op. et D.* 122) that the men of the 'golden age' became at death, 'by the counsel of great Zeus good spirits, guardians of mortal men' (*τοὶ μὲν δαίμονές εἰσι Διὸς μεγάλου διὰ βουλὰς | ἐσθλοί, ἐπιχθόνιοι, φύλακες θνητῶν ἀνθρώπων*, a passage quoted by Plato twice) and that the men of the 'silver' race became in a lower degree *μάκαρες*, 'blessed', though the poet regards them as living beneath the earth and not as functioning in our upper world as 'angels' (ib. 141 *τοὶ μὲν ὑποχθόνιοι μάκαρες θνητοῖς καλέονται | δεύτεροι, ἀλλ' ἔμπης τιμὴ καὶ τοῖσιν ὀπηδεῖ*). The Orphic belief was that every *ψυχή* was a fallen *δαίμων*, which at the end of its purgatorial wanderings becomes a god or *δαίμων* once more. ('Orpheus' Fr. 17, *Fr. d. Vors.*[5] ii. 175, from one of the gold plates from Petelia, *εἰπεῖν "Γῆς παῖς εἰμὶ καὶ Οὐρανοῦ ἀστερόεντος, | αὐτὰρ ἐμοὶ γένος οὐράνιον· τόδε δ' ἴστε καὶ αὐτοί"*, Fr. 18, ib. ii. 176, on a gold plate from Thurii, *καὶ γὰρ ἐγὼν ὑμῶν γένος ὄλβιον εὔχομαι εἶμεν, | ἀλλά με Μοῖρ' ἐδάμασσε καὶ ἀθάνατοι θεοὶ ἄλλοι*, Fr. 19, ib. *καὶ γὰρ ἐγὼν ὑμῶν γένος ὄλβιον εὔχομαι εἶναι, | ποινὰν δ' ἀνταπέτεισ' ἔργων ἕνεκ' οὔτι δικαίων*; Empedocles Fr. 115 = R. P. 181 *ἔστιν Ἀνάγκης χρῆμα, θεῶν ψήφισμα παλαιόν, ... | εἰνέτε τις ἁμπλακίῃσι φόνῳ φίλα γυῖα μιήνῃ, | Νείκεΐ θ' ὃς κάπίορκον ἁμαρτήσας ἐπομόσσῃ, | δαίμονες ... | τρὶς μὶν μυρίας ὥρας ἀπὸ μακάρων ἀλαλῆσθαι | ... | τῶν καὶ ἐγὼ νῦν εἰμι, φυγὰς θεόθεν καὶ ἀλήτης.*) The present passage takes us one step further. The Orphic *ψυχή*, which is divine and immortal, was after all a sort of 'subliminal' self, quite different from the normal waking self. As Pindar said, it 'sleeps while the body wakes' (*εὕδει πρασσόντων μελέων*). T. is expressing the view that a man's attendant *δαίμων* is his 'rational self'. Socrates means the same thing when he says in the myth of Er that the souls about to be reborn are not 'allotted' to a *δαίμων* but choose one for themselves (*Rep.* x. 617 e 1 *οὐχ ὑμᾶς δαίμων λήξεται ἀλλὰ ὑμεῖς δαίμονα αἱρήσεσθε*). That is, character *is* destiny. Cf. *Laws* v. 726 a 2 *πάντων γὰρ τῶν αὐτοῦ κτημάτων μετὰ θεοὺς ψυχὴ θειότατον, οἰκειότατον ὄν* and x. 904 b 7 where we are told that the supreme law of the soul's destiny is that God *μεμηχάνηται ... τὸ ποιόν τι γιγνόμενον ἀεὶ ποίαν ἕδραν δεῖ μεταλαμβάνον οἰκίζεσθαι καὶ τίνας ποτὲ τόπους· τῆς δὲ γενέσεως τοῦ ποίου τινὸς ἀφῆκε ταῖς βουλήσεσιν ἑκάστων ἡμῶν τὰς αἰτίας. ὅπῃ γὰρ ἂν ἐπιθυμῇ καὶ ὁποῖός τις ὢν τὴν ψυχήν, ταύτῃ σχεδὸν ἑκάστοτε καὶ τοιοῦτος γίγνεται ἅπας ἡμῶν ὡς τὸ πολύ.* Xenocrates was not really going beyond his master when he said that the *ψυχή* actually is each man's *δαίμων*.

90 a 6. φυτὸν οὐκ ἔγγειον ἀλλὰ οὐράνιον. I think it is implied in the *φαμεν ... ὀρθότατα λέγοντες* that this famous phrase that man is a tree

whose roots are in heaven is not coined here by Plato for the first time but was actually current among the Pythagoreans. The emphatic *ὀρθότατα λέγοντες*, 'and very right we are', would be a piece of tactless self-commendation if we are to suppose that T. has just invented the saying. Probably the words are really suggested by the very analogy noticed by Aristotle between the head in animals and the root in plants (the root being, so to say, the mouth through which the plant draws its sustenance) Arist. *de Anima* B. 416ᵃ 4 *ὡς ἡ κεφαλὴ τῶν ζῴων οὕτως αἱ ῥίζαι τῶν φυτῶν*, 412ᵇ 3 *αἱ δὲ ῥίζαι τῷ στόματι ἀνάλογον· ἄμφω γὰρ ἕλκει τὴν τροφήν*. Cf. *de partib. Animal.* Δ. 678ᵃ 12, where Aristotle remarks that in animals the stomach and intestines, where *τροφή* is concocted, are what the soil is to plants, and the blood-vessels through which the product is distributed to the body at large are homologous with the roots of a plant, *τοῖς δὲ ζῴοις ἡ κοιλία καὶ ἡ τῶν ἐντέρων δύναμις γῇ ἐστίν, ἐξ ἧς δεῖ λαμβάνειν τὴν τροφήν· διόπερ ἡ τοῦ μεσεντερίου φύσις ἐστίν, οἷον ῥίζας ἔχουσα τὰς δι' αὐτῆς φλέβας*. T.'s remark is a spiritualization of this. Man lives not by bread alone but by spiritual food, and is thus a plant whose 'root', through which he gets his spiritual food of good and right thoughts, is in the head, and that is why we are like trees with their roots in the sky. The idea is at bottom 'as the branch cannot bear fruit unless it abide in the vine, so neither can ye unless ye abide in me'. Timaeus perhaps intends incidentally to correct Anaxagoras who had spoken of plants as 'animals fixed in the earth' (Plutarch *Q. N.* 911 d = R. P. 160 *ζῷον ἔγγειον τὸ φυτὸν εἶναι*). T. says one should rather say that man is a *φυτόν* rooted in the *οὐρανός*.

90 b 1–6. *τῷ μὲν οὖν . . . ηὐξηκότι.* We are back at the old apologue of the 'three lives', the words *περὶ τὰς ἐπιθυμίας ἢ περὶ φιλονικίας* being descriptive of the *φιλήδονος* or *φιλοσώματος βίος* and the *φιλότιμος βίος* respectively. We are to think of these as the lives in which the *ἐπιθυμητικόν* and the *θυμοειδές* in the soul are nourished and exercised at the cost of the *λογιστικόν*. Men of these types necessarily have only 'mortal thoughts' (*δόγματα θνητά*. T. is thinking of the adage *θνητὸν ὄντα θνητὰ καὶ φρονεῖν*). Such men are doing all they can to divest themselves of their immortality by 'growing the *θνητόν* in the soul great', feeding it fat, at the expense of the *θεῖον*. For the humorous touch intended in the *ηὐξηκότι* cf. the longer development of the thought itself at *Phd.* 80 c 1—81 e 3, where 'it is playfully made to explain 'ghost stories', and for the thought itself Spinoza's proposition, *pars mentis aeterna est intellectus, per quem solum nos agere dicimur* (*Ethics* v. 40 Coroll.).

90 b 6. The man who devotes himself to *μαθήσεις*—i.e. the *φιλόσοφος*—on the other hand has developed the 'divine part' by 'thinking divine and immortal thoughts' and therefore attains *ἀθανασία* in the fullest degree possible to man; in Spinoza's language, he has a mind *cuius maxima pars est aeterna.* We see that *φιλομαθία* is here plainly equated with *φιλοσοφία*, exactly as Aristotle makes the 'student's' life, the *βίος θεωρητικός*, that in which man comes nearest to the felicity of God. We must remember that it is Timaeus who speaks. He had tried both the life of action (the *βίος φιλότιμος*, Aristotle's *πρακτικὸς βίος*) and that of the 'thinker' (the *βίος φιλόσοφος* or *θεωρητικὸς βίος*), as Socrates has been

careful to inform us, and is thus, as ἔμπειρος of both, fully qualified, on the principles laid down in the *Republic*, to judge between them. He gives his verdict for the 'life of the looker-on' as unreservedly as Aristotle. But we must remember that this was not the view of Socrates and Plato. Their preference for the βίος θεωρητικός is qualified by the conviction that it is the duty laid by God on the 'philosopher' to be a missionary and a 'saviour of society' for his fellow-men. Socrates in the *Apology* makes this the explanation of his own personal conduct, and in the *Republic* uses the same thought to justify his demand that the best years of a great thinker's life shall be given to hard administrative work. Plato says the same thing on his own account in *Ep.* vii. 326 a 5–b 4. So Plato tells us that it was from a sense of the duty of a φιλόσοφος rather than with any real hopes of success that he came to Syracuse to superintend the training of Dionysius II. *Ep.* vii. 329 b 3 ἐλθών τε ἐμαυτὸν ἠλευθέρωσα Διὸς ξενίου (i.e. did a friend's duty by Dion) καὶ τῆς φιλοσόφου ἀνέγκλητον μοίρας παρέσχον, ἐπονειδίστου γενομένης ἄν, εἴ τι καταμαλθακισθεὶς καὶ ἀποδειλιῶν αἰσχύνης μετέσχον κακῆς.

90 c 2–3. καθ' ὅσον . . . ἐνδέχεται. The restriction is necessary because what is actually immortal according to the doctrine is the ψυχή, or rather the 'divine' element in it (the *Fünklein der Seele* of the medieval German mystics), but the man is a compound of this with a perishable body. So in the *Phaedo* we hear repeatedly of the time 'before we were men' (πρὶν ἡμᾶς ἀνθρώπους γενέσθαι, 95 c 6) or 'before we assumed a human body' (πρὶν εἶναι ἐν ἀνθρώπου εἴδει, 76 c 11, πρὶν καὶ εἰς ἀνθρώπου εἶδός τε καὶ σῶμα ἀφικέσθαι, 92 b 5). Since T., formally at least, professes to believe, like Pythagoras and Empedocles, in the passage of the ψυχή into animal forms, he cannot speak of the man, but only of his ψυχή, as immortal. It is precisely to exclude the notion that a man's ψυχή can assume these animal disguises that the Church insists on the 'resurrection of the flesh'. The strictly Platonic doctrine is that the body is a mere tool or instrument of the ψυχή, which, strictly, is the man. This is fully explained in the early Academic *Alcibiades I*, where Socrates teaches Alcibiades that it is that which 'rules' the body which is really the man (130 a 11 αὐτό γε τὸ τοῦ σώματος ἄρχον ὡμολογήσαμεν ἄνθρωπον εἶναι . . . 130 c 5 ἔτι οὖν τι σαφέστερον δεῖ ἀποδειχθῆναί σοι ὅτι ἡ ψυχὴ ἐστιν ἄνθρωπος;). Timaeus, however, like Socrates in the *Phaedo*, gives the name ἄνθρωπος to the ζῷον composed of σῶμα and ψυχή.

90 c 4–7. ἅτε δὲ ἀεὶ . . . ἀποδιδόναι. The point lies in the ambiguity of the word θεραπεύειν, to 'tend'. It is the proper and technical name for (1) 'cult' or 'courtship' paid by an inferior to a superior. Thus it is technical for the cultus or 'worship' of the gods by men, and again for the 'tendance' bestowed on a 'knight' by his 'squire' (the Homeric θεράπων), on a patient by the medical man whom he employs, on a free man by his slaves. But it is also (2) technical for the 'tendance' or care bestowed on inferiors by superiors, e.g. by the ἱπποκόμος on his employer's horses, the βουκόλος on cattle, and so on. The ambiguity of such a word when applied to the religious 'tendance' of the gods by men makes a large part of the point of the little dialogue *Euthyphro*. T. is playing on this same ambiguity. The man who best θεραπεύει, 'takes the greatest

care of' the divine creature lodged in his head (like an ἱπποκόμος 'tending' a valuable horse), is also practising the true θεραπεία in the other sense, he is the 'true worshipper' who is paying λογικὴ λατρεία (*Romans* xii. 1) to God. Hence he is the true εὐδαίμων or 'lucky' man for a double reason. His λογιστικόν, which *is* his δαίμων, is getting the right 'tendance' and is in the pink of condition,[1] and also, since εὐδαιμονία is the great gift the gods bestow on those who worship them in the right way, he gets this blessing to the full. The full meaning is thus that εὐδαιμονία, 'having a good luck', belongs neither to the φιλοσώματος nor to the φιλότιμος but to the φιλόσοφος, because he *tends* his δαίμων properly and so always has it εὖ κεκοσμημένον, in first-rate condition. One may compare the saying of Heraclitus (Fr. 121 Bywater = Fr. 119 D., R. P. 48 b) ἦθος ἀνθρώπῳ δαίμων, or that of Democritus (a pupil of the Pythagoreans), εὐδαιμονίη οὐκ ἐν βοσκήμασιν οἰκεῖ οὐδὲ ἐν χρυσῷ· ψυχὴ οἰκητήριον δαίμονος (Fr. 171 D., *Fr. d. Vors.*[3] ii. 95, R. P. 205 a).

It might fairly be said that the history of Greek moral ideals is just the spiritualizing of the notion of εὐδαιμονία, which began by meaning simply 'good luck', 'prosperity', so that in poetry εὐδαίμονες, like Horace's *beati* often means no more than 'the well-to-do', until it is identified with the 'health of the soul'.

In the sentence c 6–7 θεραπεία . . . ἀποδιδόναι the παντός is quite general. 'A man can only tend anything in one way, viz. by providing it with suitable food and exercise.' It is wrong to limit the sense of this general maxim by supposing παντός to mean more specially 'any of the constituents of the ψυχή'. The 'tendance' of anything, an ox, a dog, a horse, your own soul, consists in seeing that it gets the right diet and the right exercise. If it gets these, it will be in good condition. (A.-H.'s error on this point is due to adoption of the false reading πάντως, a mere blunder of the *diorthotes* of A, for παντός. Now that F W are known to read παντός, the corruption will presumably disappear from future editions.)

90 c 7–d 7. τῷ δ' ἐν ἡμῖν . . . χρόνον. The right movements for the 'divine' in us are, of course, 'thoughts' and 'revolutions' which are of the same kind as those of τὸ πᾶν, the 'macrocosm'. So the true 'tendance' of our δαίμων, which is also the true 'worship' of God, consists in correcting the 'perturbations' of the circles in the head by learning to discern the circles in the πᾶν and their ἁρμονίαι and then making the circles in ourselves once more, as they were at our creation, accordant with their original. Thus T. weaves together the Pythagorean thought of science as revealing the celestial melody and the constantly recurring thought of so many Platonic dialogues, pretty certainly also Pythagorean (Art. PYTHAGOREANISM *ERE.* x, p. 526, col. b), that our task in life is to 'follow God' or 'become like God' (ὁμοίωσις θεῷ κατὰ τὸ δυνατόν). We become like God when the revolutions in the soul, or the head, are brought into tune with the cosmical revolutions, and this is also the condition of our being 'sensitive' to the music made by the celestial bodies.

[1] Clement of Alexandria repeats the thought in a neat form when he says (*Strom.* ii. 131, Stählin, p. 185) αὐτὸς δὲ ὁ Πλάτων τὴν εὐδαιμονίαν τὸ εὖ τὸν δαίμονα ἔχειν, δαίμονα δὲ λέγεσθαι τὸ τῆς ψυχῆς ἡμῶν ἡγεμονικόν, τὴν δὲ εὐδαιμονίαν τὸ τελειώτατον ἀγαθὸν καὶ πληρέστατον λέγει.

90 e 1—92 c 3. καὶ δὴ καὶ τὰ νῦν . . . μεταβαλλόμενα. T. has now completed his programme; he has dealt with cosmogony up to and inclusive of the appearance of man on the scene. But there are still two topics which cannot be wholly passed over, though it is enough to deal with them in a summary way, the rise of the distinction between the sexes and the production of the lower animals. We must not take what T. says about these matters too seriously, as most exponents of Plato do. Both the notion that the earliest living creatures were not as yet differentiated into male and female, and the notion of the gradual emergence of successive species come from the account given by Empedocles of the formation of a *κόσμος* in that half of the cycle in which *νεῖκος* is slowly getting the better of *φιλία* (the half-cycle in which we are actually living). Plato treats the second theory in a way which is unmistakably playful. It may fairly be doubted whether Timaeus himself is supposed to 'keep a straight face' to the end; that Plato is mainly in fun is quite certain. So, as to the first point, the alleged origin of sex, we can be sure that Plato is not in earnest with it, since he has put the same theory into the mouth of the comedian Aristophanes in the *Symposium* and has made Aristophanes introduce the tale with a reference to his own calling as a professional *γελωτοποιός*. Zeus, according to this pretended cosmogony, split the original bi-sexual 'men' in half longitudinally, for fear of their storming Olympus, and if we continue to misbehave, he may repeat the operation and leave us to hop on one leg. It is quaint that earnest-minded dullards have found a profound 'metaphysic of sexual love' in this Rabelaisian jest. It is simply fun, admirably suited to the character of Aristophanes who utters it. (See the excursus on the speeches of Aristophanes and Eryximachus in the *Symposium* infra.) Even Timaeus treats things very airily. He has finished his real exposition and feels no need to expatiate (*μηκύνειν*). We may suspect that he is 'ragging' his own authority Empedocles in a decorous way. (Plato, as the *Parmenides* exists to prove, had a certain 'impish' humour which might well break out by making his Pythagorean wind up with a jest at the expense of one of his own authorities.) Possibly T. feels that, as a Pythagorean, he is bound to say something about 'transmigration', but that it is best not to be too serious about such a questionable point. At any rate it is wholly wrong to suppose that Plato is in deadly earnest, and to raise the question whether there really is an 'ontological significance' in difference of sex or whether anything could really be made of a doctrine of the evolution of species *au rebours*. The very words with which T. finishes up his little prelude to the section, *τῇδ' οὖν τὸ τοιοῦτον ἔστω λεγόμενον*, 'So the following will do for an account of that', are not those of a man who is wholly serious.

90 e 6—91 d 5. τῶν γενομένων ἀνδρῶν . . . ἀποτελέσωσι γένεσιν. *Sex.* Sex came in in the second generation, when the more cowardly and unfair men were reborn as women. We must not moralize here on the 'inadequate ideal of womanhood' in the ancient world. That women are more timid than men and less scrupulously fair in their dealings may or may not be true, but it is the average man's opinion all the world over as the modern novel and comic paper are enough to prove. As such, the assumption is good enough to build a humorous fairy-tale on. (Proclus,

among whose great gifts a sense of humour was not included, has gone very carefully into the question of Plato's real theory about women in connexion with his exposition of 42 b 5, and laboriously pointed out the difficulties into which we get if we take this account of the origin of the sexes and the tales in the myth about the souls of men being reborn as women seriously. He insists very strongly that the real meaning is merely that there are 'manly' and there are 'womanish' ψυχαί; Plato does not mean to say that the 'manly' soul always has a male body or the 'womanish' a female.

It is interesting to contrast Aristotle's remarks about the ultimate reason for the separation of the sexes in the higher animals. Ar. held that the female parent provides all the *material* for the body of the offspring; the male, in the act of fertilization, provides no material, but supplies the initial impulse or ἀρχὴ κινήσεως which leads to the working up of this material into a fresh living creature. He actually goes the length of saying (*de generat. Animal.* B. 738^{b} 25) ἔστι δὲ τὸ μὲν σῶμα ἐκ τοῦ θηλέος, ἡ δὲ ψυχὴ ἐκ τοῦ ἄρρενος. The ψυχή meant is the αἰσθητικὴ ψυχή characteristic of ζῷα, since νοῦς comes 'from outside', and the mere θρεπτικὴ ψυχή which is common to ζῷα and φυτά is *potentially* present in the female herself, for, as Ar. observes, an ordinary unfertilized hen's egg will 'go bad'. It has not even the θρεπτικὴ ψυχή in actual fact (ἐνεργείᾳ), since the egg does not feed or grow, but it has it 'potentially', it is not *mere* lifeless matter. But the efficient and formal causes are worthier or nobler than the material, and therefore 'it is better' that there should be a sharp distinction, and that the nobler and less noble causes should not be combined, as in plants, in one organism. 'Hence whenever possible, and so far as possible, the male is separate from the female' (ἐν ὅσοις ἐνδέχεται καὶ καθ' ὅσον ἐνδέχεται, κεχώρισται τοῦ θήλεος τὸ ἄρρεν.) The humour of the situation is that though these remarks may be meant as a 'score' off the theory expounded by Timaeus, it was Plato who denied the natural inferiority of women with its consequences, the doctrine of their social subjection, and maintained that since 'the ἀρετή of a man and of a woman is the same', both should have the same education, while Aristotle insisted vigorously on this inferiority, declaring expressly that the relation of husband to wife is one of superior to inferior and that, though in a sense there may be an ἀρετή of a woman, she is absolutely speaking an 'inferior thing' (*Politics* A. 1254^{b} 13 ff., 1259^{b} 2 ff.). So he held that biologically a female is a sort of 'imperfect male', an 'arrested development' (*de generat. Animal.* A. 728^{a} 17 καὶ ἔστιν ἡ γυνὴ ὥσπερ ἄρρεν ἄγονον. ἀδυναμίᾳ γάρ τινι τὸ θῆλύ ἐστι, τῷ μὴ δύνασθαι πέττειν ἐκ τῆς τροφῆς σπέρμα τῆς ὑστάτης, ib. B. 737^{a} 27 τὸ γὰρ θῆλυ ὥσπερ ἄρρεν ἐστὶ πεπηρωμένον). These doctrines are really more in keeping with the ideas T. is expounding than are Plato's own views about the capabilities of women.

91 a 1–2. κατ' ἐκεῖνον δὴ τὸν χρόνον . . . ἐτεκτήναντο. A side hit at the theogonies and cosmogonies which made Eros, the sexual impulse, one of their primary figures, like that of Empedocles himself, whose cosmic force φιλία is expressly declared to be what men know in themselves as Ἀφροδίτη, the sexual attraction which draws male and female together (Fr. 17, R. P. 166 καὶ Φιλότης ἐν τοῖσι . . . | ἧτις καὶ θνητοῖσι νομίζεται ἔμφυτος ἁρθροις, | τῇ τε

φίλα φρονέουσι καὶ ἄρθμια ἔργα τελοῦσι, | Γηθοσύνην καλέοντες ἐπώνυμον ἠδ' Ἀφροδίτην). So in the cosmogony and theogony of the second part of the poem of Parmenides, Eros is said to have been the first of the gods to be formed by Ἀνάγκη (Parm. Fr. 13, R. P. 125 πρώτιστον μὲν Ἔρωτα θεῶν μητίσατο πάντων). Hesiod, who makes his primitive figures Chaos, Earth, Tartarus, and Eros is another case in point (*Theogony* 116 ἤτοι μὲν πρώτιστα Χάος γένετ', αὐτὰρ ἔπειτα | Γαῖ' εὐρύστερνος, πάντων ἕδος ἀσφαλὲς αἰεί, | Τάρταρά τ' ἠερόεντα . . . | ἠδ' Ἔρος). In the *Symposium* (178 b 5 ff.) Phaedrus quotes these lines and those of Parmenides, and adds that Acusilaus also made Earth and Eros the first of things after Χάος. Agathon, on the other side, tries to show his originality by maintaining that Eros is the youngest of the gods (*Sympos.* 195 a 8). But he evidently knows that all the theogonies are against him, since he argues that if Hesiod and Parmenides were right, and Eros had existed in the beginning, the deeds of violence done on one another by the early gods would never have occurred. He has no *authorities* to oppose to them. According to the famous tale Socrates professes to have learned from Diotima, Eros is not even a god at all, but a δαίμων intermediate between god and man, begotten by Πόρος (Plenty) on Πενία (Want) (*Sympos.* 203 b–c.) Since the whole point of the emphatic κατ' ἐκεῖνον τὸν χρόνον is to contradict the theogonies by insisting that Eros was made by 'the gods' when the first generation of men had passed away, and not before, T. is plainly not in accord with Empedocles when it comes to theogony, and this should prepare us for other hints that he is now relieving the tedium by a little *persiflage*.

91 a 2–4. ζῷον . . . ἑκάτερον. The main point to be borne in mind in the description of the anatomical and physiological modifications required in the second generation is that T. thinks of the sexual impulse as an actual ζῷον, an animal living in us, and a very unruly animal. The principal anatomical change is that in the male animal a passage was bored by which the spinal marrow henceforth communicated directly with what had hitherto been a mere conduit to carry away waste liquid from the body. There were answering modifications to be made in what was now to be the female, but these are not described at length. The γονή of animals is thus, according to the theory, an actual portion of the spinal μυελός which gets out at this newly-formed exit. The question about the part played by male and female in procreation keenly interested the fifth-century biologists, who were particularly concerned to determine whether both προίενται σπέρμα or not, and whether the σπέρμα is secreted from every part of the body or not. T., like Aristotle, definitely rejects the theory that it is a secretion from 'the whole of the body and every part of the body', and perhaps also the theory that it is furnished by both parents. This, says Aristotle, is the view suggested by the passages of Empedocles dealing with the subject (*de general. Animal.* A. 722^{b} 8 διὸ καὶ Ἐ. ἔοικεν, εἴπερ οὕτω λεκτέον, μάλιστα λέγειν ὁμολογούμενα τούτῳ τῷ λόγῳ, τό γε τοσοῦτον, ἀλλ' εἴπερ ἑτέρᾳ πῃ, οὐ καλῶς). The same views appear in the Hippocratean περὶ γονῆς, which may thus probably be regarded as a production of the Sicilian school. (Kühn i. 371 ἡ δὲ γονὴ τοῦ ἀνδρὸς ἔρχεται ἀπὸ παντὸς τοῦ ὑγροῦ τοῦ ἐν τῷ σώματι ἐόντος τὸ ἰσχυρότατον ἀποκριθέν, 372 ἔρχεται

εἰς τὸν νωτιαῖον μυελόν, 373 χωρέει γὰρ τὸ πλεῖστον τοῦ γόνου ἀπὸ τῆς κεφαλῆς παρὰ τὰ οὔατα εἰς τὸν νωτιαῖον μυελόν, 374 τὴν δὲ γονὴν φημι ἀποκρίνεσθαι ἀπὸ παντὸς τοῦ σώματος, καὶ ἀπὸ τῶν στερεῶν καὶ ἀπὸ τῶν μαλθακῶν καὶ ἀπὸ τοῦ ὑγροῦ παντὸς τοῦ ἐν τῷ σώματι. On the point about the part played by the female the writer says, i. 378 οὕτως ὁ λόγος ἐρέει [l. αἱρέει] καὶ τὸν ἄνδρα καὶ τὴν γυναῖκα ἔχειν καὶ θῆλυν γόνον καὶ ἄρσενα, 380 ἔνεστι καὶ ἐν τῇ γυναικὶ καὶ ἐν τῷ ἀνδρὶ καὶ κουροgονίη καὶ θηλυγονίη.)

If we compare these views with those of Timaeus, we see that there is a point of agreement. Both theories assert that there is a special connexion between the brain and μυελός and the γονή, but while the περὶ γονῆς adopts the view which Aristotle ascribes to Empedocles, that the γονή is a secretion from all parts of the body, T. holds that it is the actual substance of the μυελός itself. As for the further assertion which Aristotle regarded as made by Empedocles that the female also contributes γονή, it is expressly maintained in the περὶ γονῆς but not actually made by T.

T.'s theory again disagrees on a fundamental point with Aristotle's. Aristotle holds that the γονή of the male is secreted from that part of the blood which is not needed for the maintenance of the parent organism (περίττωμα χρησίμου τροφῆς καὶ τῆς ἐσχάτης, *de generat. Animal.* A. 726ª 26), T.'s theory is that the γονή is actually μυελός. As to the further question whether the female also προίεται γονήν and, if so, whether this contributes anything to the generation of the offspring, as Empedocles had maintained (Aristot. *de generat. Animal.* A. 722ᵇ 10 φησὶ γὰρ ἐν τῷ ἄρρενι καὶ τῷ θήλει οἷον σύμβολον ἐνεῖναι, ὅλον δ' ἀπ' οὐδετέρου ἀπιέναι, "ἀλλὰ διέσπασται μελέων φύσις, ἡ μὲν ἐν ἀνδρός . . . ", Emped. Fr. 63), v. n. on 91 c–d *infra*. Aristotle definitely rejected the Empedoclean view on this point as due to malobservation (*de generat. Animal.* A. 727ª 27 φανερὸν ὅτι τὸ θῆλυ οὐ συμβάλλεται σπέρμα εἰς τὴν γένεσιν, ib 727ᵇ 33). What the θῆλυ contributes, according to him, is 'superfluous blood', and this is the whole 'matter' of the body of the offspring (ib. 727ᵇ 31 ὅτι μὲν οὖν συμβάλλεται τὸ θῆλυ εἰς τὴν γένεσιν τὴν ὕλην, τοῦτο δ' ἐστὶν ἐν τῇ τῶν καταμηνίων συστάσει, τὰ δὲ καταμήνια περίττωμα, δῆλον).

91 b 2–3. λαβὼν . . . ἀνέπνευσεν. The text appears to me sound. τοῦθ' and ἀναπνοήν seem to be in apposition. 'Finding as a vent that where it did (in fact) get a vent' = 'finding an outlet in the place we know of'. Apparently T. wishes to avoid the use of a technical medical term such as οὐρήθρα. (He is not intending a 'euphemism' for the common αἰδοῖον, a word employed in literary prose and used by himself in the next sentence.) For the circumlocution cf. such phrases as παθὼν ἅπερ ἔπαθεν, πράξας ἃ ἔπραξεν. The soundness of τοῦθ' seems to be guaranteed by the following αὐτῷ, which refers back to it. I do not see that there is more reason for objecting to τοῦτο as an antecedent to ᾗπερ than for finding fault with Aristophanes' λόγους ὅπου γυνὴ πονηρὰ | ἐγένετο (*Thesmophor.* 546) or the τὸ δὲ . . . ταύτῃ of 39 e 4–5 supra (v. n. in loc.). But it is also possible to take ᾗπερ ἀνέπνευσεν not with λαβὼν ἀναπνοήν but with the following ἀπετέλεσεν, 'and when it had got this (the opening described in a 6–7) as a vent, causing in it a vivid appetite for discharge, it created a passion for procreation in the part where it found the outlet'. This seems to be the interpretation of Fraccaroli, though he, wrongly, as I think, accepts

Stallbaum's *ταύτῃ* for *τοῦθ'*. A third possibility is to take *ἥπερ ἀνέπνευσεν* with *ἐμποιήσας*. 'Having got this as a vent, it created a passion for procreation by causing in it, at the place where it got that vent, a vivid appetite for discharge.' This is the construction presupposed by Apelt's rendering. The general construction of the sentence seems to me in favour of the interpretation I have given first; the other two make *ἥπερ ἀνέπνευσεν* otiose. Martin's version assumes my own view of the construction.

91 b 7–c 6. αἱ δ' ἐν ταῖς γυναιξίν. For these remarks about the consequence of enforced celibacy in women, 'the mother', to use the Shakespearian word, cf. Arist. *de generat. Animal.* A. 719ᵃ 20. For the *ἀναπνεῖν οὐκ ἐῶν* in particular cf. Aristotle's *κεναὶ δ' οὖσαι αἱ ὑστέραι ἄνω προσιστάμεναι πνίγουσιν.*

91 c 3. παρὰ τὴν ὥραν. St. took this to mean 'throughout her prime', the time when she is fitted by nature for maternity. His parallels show that there would be no verbal impossibility in such a rendering. But the context favours the alternative rendering 'beyond due season', *praeter pubertatem* (M., A.-H.). A.-H. reminds us that there is an exact parallel in *Critias* 113 d 3 *ἤδη δ' εἰς ἀνδρὸς ὥραν ἡκούσης τῆς κόρης*, 'when the maid came to marriageable age'. T. cannot well mean that enforced sterility is only baneful if it lasts through the whole period within which maternity is possible. T. is probably thinking of the various physical and mental oddities which both sexes manifest at the period of puberty. As we have had no description of the formation in the female of a counterpart to the *ἔρως τοῦ γεννᾶν*, one may perhaps suppose that T. regards the passion as due in both sexes to the same cause, the attempt of the *μυελός* to find an exit. If so he would be accepting the Empedoclean theory that *τὸ θῆλυ συμβάλλεται σπέρμα ἐν τῇ συνουσίᾳ* with its corollary that half the material of the child's body is furnished by each parent. Yet his very next sentence (91 d 2 ff.) suggests the cruder view that the whole of the child's body comes from the father and that the mother merely provides a temporary receptacle in which it grows as the seed does in the earth and a supply of *τροφή*. If he means this, he has left it unexplained how there comes to be an *ἔρως* of female for male. If he means to take the view of Empedocles, he has used a very unsatisfactory metaphor in comparing the *μήτρα* to *ἄρουρα*. His embryology has clearly not been worked out very completely.

91 d 1. συναγαγόντες. Now that this, the reading of A and Stobaeus, is known to be supported by F, there is no reason for admitting Hermann's cj. *συνδυάζοντες*, which was meant to account for the mere blunder of A² and P, *συνδιαγαγόντες*. A.-H. is mistaken in saying that the *tense* of the participle *συναγαγόντες* is wrong. It is not only right but necessary. Of course the couple must be 'brought together' *before* anything further can take place.

91 d 1–5. οἷον ἀπὸ δένδρων . . . γένεσιν. As already remarked, this suggests the view that a mother is not akin by blood to her offspring. The theory is familiar to us from the use made of it by Loxias in his very sophistical defence of Orestes in the *Eumenides* 658 ff. *οὐκ ἔστι μήτηρ ἡ κεκλημένη τέκνου | τοκεύς, τροφὸς δὲ κύματος νεοσπόρου. | τίκτει δ' ὁ θρώσκων, ἡ δ' ἅπερ ξένῳ ξένη | ἔσωσεν ἔρνος, οἷσι μὴ βλάψῃ θεός.* I have not

been able to discover whether this view was held by any of the scientific schools in the fifth century. The doxographical records about the embryology of the early φυσικοί are particularly scanty. Aetius (*Placita* v. 5, *Doxogr. Graec.* 418) mentions Pythagoras and Hippo of Samos (whom Burnet has shown to have been a Pythagorean), as holding that αἱ θήλειαι προίενται σπέρμα, but, as Pythagoras wrote nothing, his views are probably here simply presumed to have been the same as Hippo's, and according to Aetius Hippo said μὴ μέντοι εἰς ζῳογονίαν τοῦτο συμβάλλεσθαι. This does not prove that he held that the female is not really a parent of what we call her child. It would be consistent with a theory like that of Aristotle, and it is curious that Aetius (op. cit. v. 3. 2) ascribes to Pythagoras exactly Aristotle's theory about the *male* σπέρμα, that it is ἀφρὸς τοῦ χρηστοτάτου αἵματος, περίττωμα τῆς τροφῆς, ὥσπερ [τὸ] αἷμα καὶ μυελός. That the σπέρμα is μυελός is a view also ascribed to Hippo by Censorinus 5. 2, *Fr. d. Vors.*[3] i. 134, 290.

91 d 2. ἀόρατα ὑπὸ σμικρότητος. We must not credit Plato or Timaeus with having divined the 'spermatozoon'. The ζῷον spoken of here is supposed to be the future infant itself in miniature, as we see from the words μεγάλα . . . εἰς φῶς ἀγαγόντες. 'It is true that we call the carrier of the generative element . . . the spermatozoon, but the spermatozoon of a rhinoceros is not a little rhinoceros' (Platt on Arist. *de generat. Animal.* 722[b] 4). The διακρίναντες of d 3 refers to the gradual differentiation of the embryo. The most profitable passage for comparison with T.'s remarks is perhaps Hippocr. περὶ τροφῆς (Kühn ii. 23) where we are told that the articulation of the human embryo is completed in 35 days (5 × 7), it begins to move in 70 (10 × 7) and reaches τελειότης at the earliest in 210 (30 × 7). Another reckoning is that articulation is completed in 45 days, motion begins after 76, τελειότης after 210. Still another is that 50 days are required for articulation, 100 ἐς πρῶτον ἅλμα, 300 ἐς τελειότητα. Another reckoning is 40 days ἐς διάκρισιν, 80 ἐς μετάβασιν, 240 ἐς ἔκτωσιν. It will be noted that all the reckonings except the second are based on the progression 1–2–6, and that the first makes all the terms mulitples of the ἑβδομάς. According to Nicomachus (ap. *Theolog. Arithm.* 47) Strato the Peripatetic and Diocles of Carystus taught that after 35 days the embryo is completely articulated but only as large as a bee. So also Proclus *in Remp.* (Kroll) ii. 33 οἱ δὲ Πυθαγόρειοι προσίενται, ὡς καὶ Ὀρφεύς, καὶ τὰ ἑπτάμηνα, καὶ φασὶν ἐν μὲν λε ἡμέραις τὸ καταβληθὲν σπέρμα τύπον καὶ μορφὴν λαμβάνειν, Macrobius *in Somn. Scip. I*, vi. 65. It is to ideas of this kind that T. is meant to be alluding.

91 d 5—92 c 3. γυναῖκες μὲν οὖν . . . μεταβαλλόμενα. *Evolution of the lower animals.* The brief account of the lower species and of transmigration is manifestly little more than friendly burlesque. No one doubts that the original Pythagoreans were in earnest with the belief, but it is quite another question what men like Philolaus and Timaeus thought of it. Socrates employs it in the myths which conclude the *Phaedo* and *Republic* and should be compared with the present passage, but Plato never makes him allude to it except when he is telling one of his imaginative myths, as he makes him allude to and argue for the immortality of the soul; it would therefore be unsafe to credit him with serious belief in

it, especially as it is hard to reconcile with the doctrine ascribed to him in the *Republic* about the tripartite soul, since animals are expressly held there to have no λογιστικόν. It is noticeable, too, that in these eschatological myths Socrates seems to be combining two beliefs which come from different quarters, the belief in a life after death in 'another world', and the very different belief that a ψυχή at death passes into a human or animal body, which, of course, belongs to *this* world. This is, perhaps, the eschatology which is best accredited for Pythagoras, since there seems no doubt that the lines of Xenophanes about the man who recognized the voice of his departed friend in the howls of a dog (Fr. 7 = R. P. 88) really refer to him. (Empedocles, too, seems to have conceived of the doom of the fallen δαίμων as an unbroken series of reincarnations, Fr. 115 = R. P. 181, Fr. 117 = R. P. 182.) The Paradise and Hell (or Purgatory) which Socrates gets in by making long periods of reward or punishment for the 'parted' soul intervene between the incarnations seem to belong to a different type of doctrine; since you get punishment for the deeds done in the flesh twice over if Purgatory and reincarnation as a brute are both in your scheme. Timaeus drops out Paradise and Purgatory, and retains only reincarnation as a beast in his penal scheme. The fallen soul enters the bodies of beasts and only becomes a man again after sufficient purification; it apparently does not get intervals of Paradise after one embodied life and before another, if it has done well, as the souls in the *Republic* myth do. It only reaches Paradise as the final stage of an upward journey and apparently never leaves it again. Plato, on the other hand, at *Laws* x. 904 a 6 ff., where we seem to come nearer than anywhere else to his own inmost beliefs, finds a place for a Hell or Purgatory, but says not a word about transmigration into animal forms, although he does refer to successive births and deaths. He lays it down there that the soul, like everything else, is subject to the great law that 'like' gravitates to 'like'. It is a direct consequence of this law, which needs no special further divine 'intervention', that our society in life and 'in all deaths' will always be that of those who are like what we have made ourselves, "αὕτη τοι δίκη ἐστὶ θεῶν οἳ Ὄλυμπον ἔχουσιν," ὦ παῖ καὶ νεανίσκε ἀμελεῖσθαι δοκῶν ὑπὸ θεῶν, κακίω μὲν γιγνόμενον πρὸς τὰς κακίους ψυχάς, ἀμείνω δὲ πρὸς τὰς ἀμείνους πορευόμενον, ἔν τε ζωῇ καὶ ἐν πᾶσι θανάτοις πάσχειν τε ἃ προσῆκον δρᾶν ἐστι τοῖς προσφερέσι τοὺς προσφερεῖς καὶ ποιεῖν (904 e 4—905 a 1). This, he explains, is the reality which lies behind men's terror-stricken dreams of Hell (ὅσα Ἅιδην τε καὶ τὰ τούτων ἐχόμενα τῶν ὀνομάτων ἐπονομάζοντες σφόδρα φοβοῦνται καὶ ὀνειροπολοῦσιν ζῶντες διαλυθέντες τε τῶν σωμάτων, ib. 904 d 1–4), and it cannot be escaped by any one (ib. 905 a 6–b 2). The absolute silence about any migration into animal forms, which might so easily have been got in as one way of sinking into the company of 'worse ψυχαί', seems to show that such a migration was alien to Plato's own imagination. I should infer, therefore, that even the symbolic employment of 'Pythagoras' metempsychosis' belongs really to the 'historical Socrates'. T. apparently represents the whole animal kingdom as coming into being *simultaneously* with the women; members of the first generation are at once reborn as animals of different species according to their different defects.

This seems to exclude altogether the long intervals between the different rebirths of which we read in the *Phaedo* and *Phaedrus*, though they are necessary if the two types of eschatology are to be fitted into one and the same story. The details given here are manifestly humorous.

91 d 6–e 1. τὸ δὲ τῶν ὀρνέων φῦλον . . . εὐήθειαν. As the timid and unfair were turned into women, the harmless, bird-witted and inquisitive, but silly are appropriately made into actual birds. It is a natural jest in a Pythagorean that T. selects as his typical example the man who is μετεωρολογικός, interested in the 'things aloft', 'the wonders of the heavens', but 'silly' enough to think that you can get knowledge of the laws of astronomy by simple 'star-gazing'. Socrates similarly satirizes the same 'star-gazers', who do not understand that astronomy must be based on mathematical analysis of motions, at *Rep.* vii. 529 a 9 ff., where he compares them with men lying on their backs and gazing with admiration at a fretted ceiling. A Pythagorean mathematician would agree with the demand which Socrates goes on to make that astronomy, like geometry, shall be studied ἐν προβλήμασιν (530 b 6), i.e. by the propounding of problems about the analysis of complex motions into simpler ones.

91 d 7. ἀκάκων. F has the variant ἀτέχνων, 'unscientific', but this spoils the humour of the description of the man who 'has no harm in him but is bird-witted'.

91 e 2—92 a 7. τὸ δ' αὖ πεζὸν . . . ἐγέννησαν. After women and birds we come to quadrupeds, a more 'brutish' class of creatures. They are transformations of men who were too unintelligent even to be harmlessly curious, and so had no trace of the φιλόσοφος in them. The explanation that they have their heads bowed down to the ground and their arms turned into legs and their snouts lengthened, because they once were men who neglected the circles in the head and only attended to the part of the soul which is in the chest (i.e. did not rise above the level of the βίος φιλότιμος and so were sensual or quarrelsome fellows), with the very natural consequence that they now no longer see the heaven they cared nothing for, and need four legs instead of two to prop up the bodies they were too attentive to, while their faces have grown elongated from the distortion of the circles of the head, is again obviously pure humour, though Aristotle has treated it quite seriously in a passage of the *de partibus Animal.* Δ. 686^{a} 27 ff.:

'Man is the only animal which stands erect because his nature (φύσις) and true being (οὐσία) are divine. The function of that which is most divine is to understand and think (νοεῖν καὶ φρονεῖν). This is not easy if there is pressure from a vast superincumbent body, since its weight makes the motion of thought and common sensibility difficult. Hence, as weight and bodily bulk are increased, a creature's body inevitably tends down to the ground, and so Nature gave the quadrupeds forefeet instead of arms and hands as a firm support.' Thus Ar. accepts the main principle of T. that the human form, as the best which Nature can produce, is that which she is all through trying to realize, though he does not repeat the mythical and fanciful expression given to this thought by the fiction that the inferior species have been produced from an original human type by degeneration. As he goes on to say (op. cit. 686^{b} 3),

'compared with man all other animals are dwarf-like (*νανώδη*), for in the dwarfish the upper parts are large but the part which supports the creature's weight and walks is small. Now the upper part is the so-called trunk, which extends from the head to the region where the excrements are voided. In man this is properly proportioned to the lower parts and, in the full-grown, much smaller. But in infants, on the contrary, the upper parts are large but the lower small. That is why they cannot walk but only creep, and at first cannot even creep, for all small children are really dwarfs. But in men, as they grow up the lower parts grow larger. In quadrupeds, on the contrary, the lower part is biggest at first, and as they get older the development is in the direction of the upper part.... This is why all animals are less intelligent than man.... So with a further diminution of the vital heat which makes a creature erect, and a further increase of its earthy constituent, the animal's body becomes smaller and many-footed, and finally loses the feet altogether and is stretched out along the ground. As the process gradually continues and the principal part comes to be undermost, even the head at last becomes motionless and insensible, and you get a plant, which is a topsyturvey creature; for in plants the roots answer to mouth and head, and the seeds have an opposite significance, for they grow at the top and at the ends of the twigs.'

91 e 5–6. ἀλλὰ . . . μέρεσιν. This does not mean that the quadrupeds have all been *φιλότιμοι*, a class which is definitely superior to the *φιλοσώματοι*, *φιλήδονοι*, or *φιλοχρήματοι*. The *homme moyen sensuel* or *φιλόσωματος* is clearly included in this 'third' *γένος*, since the 'fourth' *γένος* is reserved for the downright depraved. The meaning is not that the class with which we are now dealing have all followed the *βίος φιλότιμος* as opposed to the *βίος φιλοχρήματος*, but that at any rate they have never risen above the level of the *βίος φιλότιμος*; many of them need not even have risen so far.

92 a 1. ὑπὸ ἀργίας, 'from inertia'. The persons in question have not even misused their 'brains', they have not used them at all; they are exactly described by Hamlet's language about allowing 'That capability and god-like reason | To *fust* in us unus'd'.

92 a 3. προφάσεως. Once more an echo of the medical terminology already illustrated from the Hippocratean corpus, in which *πρόφασις* is the standing word for the 'occasion' or 'proximate cause' of an attack of illness. Here, however, there is a slight shift of sense, since the precise meaning is 'proximate purpose', 'immediate result aimed at'. The following *θεοῦ*, which ascribes the device directly to 'God', shows that we must not press the picture of a division of labour between God and lesser 'gods' seriously. *Qui facit per alium facit per se*, and the frequent reference of particular anatomical arrangements to *θεός* as their author shows that T. really regards the whole creation as due to the 'purpose and foreknowledge' of the Supreme.

92 a 4. ὡς μᾶλλον ἐπὶ γῆν ἕλκοιντο. Thus T. assigns as the purpose of the arrangement what Aristotle in the passage quoted on 91 e 2 describes as its cause. Ar. says that Nature multiplies the number of the feet because the 'earthy constituent' in the body increases and requires more and more propping up. T. says that the number of feet is in-

creased in order that the body may be more and more drawn downwards to the earth. His thought plainly is that earth predominates in the composition of these limbs and therefore, in virtue of the tendency of 'like to like', the more numerous a creature's legs the more it tends to drag itself along close to the ground. Cf. 91 e 7 τὰς κεφαλὰς εἰς γῆν ἑλκόμενα ὑπὸ συγγενείας ἤρεισαν; the quadruped has its head nearer the ground than man because there is more 'earth' in the composition of the head itself. The 'many-footed' creatures referred to are, I take it, insects which crawl on the ground, caterpillars and the like. The conjunction of these with the quadrupeds would be a bad blunder if the passage was meant in any way seriously as a piece of 'natural history', but as T. is more than half in jest, this does not really matter.

92 a 4–7. τοῖς δ' ἀφρονεστάτοις . . . ἐγέννησαν. The unexpressed subject is 'the created gods', to whom the execution of these arrangements was entrusted. The sentence is 'anacoluthic'. It opens with τοῖς ἀφρονεστάτοις as a *dativus incommodi* as though the continuation were to be 'for the most mindless . . . they provided no feet at all'. Then, since a genitive absolute clause, ὡς . . . οὔσης, intervenes, when the main sentence is resumed the construction is changed, and we get 'they made them footless', the αὐτά being τὰ ἀφρονέστατα. If you object to 'anacoluthon', you might try to take τοῖς ἀφρονεστάτοις with οὐδὲν ἔτι ποδῶν χρείας οὔσης. But the long postponement of the ὡς is more objectionable than the admission of a variation of the construction. That the traditionally 'subtle' serpent thus ranks with e.g. *annelida* as among the ἀφρονέστατα is another indication that T. means nothing very serious by this story.

92 a 7–c 1. τὸ δὲ τέταρτον γένος . . . εἰληχότων. After women, birds, land animals of all kinds, we come to aquatic creatures, fishes, aquatic crustacea, and whatever lives in the water generally. These are transfigurations of the very worst of mankind, the most mindless of all, whose souls are utterly impure, in fact of criminals. The mere lumping together of fishes, crustacea, and molluscs in this indiscriminate fashion should show that we are dealing with humour, not with science. Perhaps T. is amusing himself by contradicting the curious theory of Empedocles that fishes are chiefly made of fire and take to the water to cool themselves (Arist. *de Respiratione* 477^{b} 27, where it is said that to be consistent E. should also have held that trees, being very dry, grow in the water, καίτοι τοῦ αὐτοῦ λόγου ἐστὶν εἰς τὸ ὕδωρ, διὰ τοῦ εἶναι αὐτὰ ὑπέρξηρα, ὥσπερ τὰ ὑπέρπυρά φησιν ἐκεῖνος, and *EGPh.*^{2} 245). In general, E. held that a creature lives in the 'element' of which there is most in its own composition, and T.'s playful account has followed him on this point, but E. did not carry the theory out when he came to deal with fishes. T. means to be thorough with the doctrine of correspondences.

92 b 2. ἀναπνοῆς καθαρᾶς. Timaeus thus assumes rightly that all animals, even 'shell-fish', breathe, a fact denied, as we have seen, by Aristotle. This was the teaching of Anaxagoras and Diogenes of Apollonia, as Aristotle says (*de Juventut.* 470^{b} 30). It was the natural view for a Pythagorean, since it is derived from the old Milesian doctrine of Anaximenes, held by at least some of the first Pythagoreans—that we actually live by 'inhaling' ψυχή from the atmosphere, or, as the Pytha-

goreans said, from the ἄπειρον. Democritus' well-known assertion that breathing is necessary to keep up the stock of soul-atoms in the body is a mere adaptation of this doctrine of Anaximenes to the atomistic view of the structure of matter. The theory has even left its traces in Aristotle's famous declaration that νοῦς, the divine element in man, is the only one which is not generated from his parents but comes 'from out-of-doors' (*de general. Animal.* B. 736b 27 λείπεται δὲ τὸν νοῦν μόνον θύραθεν ἐπεισιέναι καὶ θεῖον εἶναι μόνον· οὐθὲν γὰρ αὐτοῦ τῇ ἐνεργείᾳ κοινωνεῖ σωματικὴ ἐνέργεια). Apparently, however (see the words of b 5 εἰς ὕδατος θολερὰν καὶ βαθεῖαν ἔωσαν ἀνάπνευσιν), T. holds that creatures which live below the surface of the water breathe water. Perhaps he has in his mind the views ascribed by Aristotle to Diogenes of Apollonia who said that when fishes expel water at their gills they draw in air 'by the void in their mouths; for there is air contained in the water' (*de Juventut.* 471a 2–5). The general theory that the most mindless creatures of all live at the bottom of the sea seems reminiscent of the well-known doctrine of Diogenes, that ἰκμάς, 'damp', interferes with thought.

92 b 7–c 1. ἐσχάτας οἰκήσεις. T. clearly means, though A.-H. denies this, that the aquatic creatures live lowest down and furthest from pure air. Cf. the theory in the myth of the *Phaedo* that the whole Mediterranean basin is a sort of marsh and that its so-called 'air' is mostly water and mist, so that you would have to get right above it to be in 'the real air'. Just as the shell-fish, &c., are the worst sinners and therefore live farthest from pure air, so in the *Phaedo* it is the virtuous dead who live on the 'real dry land', breathing the 'real air', high above the swamps *we* call the οἰκουμένη. Here, too, it is obvious that a fanciful use is being made of the theory of Diogenes about ἰκμάς. As for the ὅσα ἔννδρα, they include every kind of organism found in the sea down to e.g. sponges. There is evidently meant to be a *crescendo*. A man who was condemned to become a sponge would be much worse off, and therefore must be supposed to have been a much worse sinner, than a man who had to become a φίλαυλος δελφίς.

92 c 2–3. νοῦ καὶ ἀνοίας ἀποβολῇ καὶ κτήσει. The principle is that 'to him that hath shall be given'. The creatures at the very bottom of the sea, (sponges for instance), can have only the barest rudiments of αἴσθησις. They have lost the sense-organs which they have forfeited by misuse. But it is implied in the κτήσει that a reascent is possible even from the depths.

There is a minor but interesting question suggested by this account of the lowest species. Does Timaeus mean us to gather, from his remark that the distinction of sex came in in the second generation, the conclusion that *all* animals are sexually propagated? Since he says nothing to the contrary, I suppose we are to understand that the difference persists throughout the descending series, and that there is no *generatio aequivoca*. This would apparently be in accord with the teaching of Empedocles, who seems to have asserted the sexual propagation of all creatures except those which came into being in the period when νεῖκος had not yet sufficient strength to discriminate the sexes (his monstrous bi-sexual beings who died out from inability to propagate), and those which originate when

φιλία is not yet sufficiently powerful, and begin, therefore, as 'heads without necks', i. e. as separate members and limbs. (See Aetii *Placit.* v. 19. 5, *Doxogr. Gr.* 430, R. P. 173, τὰς δὲ τετάρτας οὐκέτι ἐκ τῶν ὁμοίων, οἷον ἐκ γῆς καὶ ὕδατος, ἀλλὰ δι' ἀλλήλων ἤδη.) It would thus appear that E. did not believe in *generatio aequivoca* as a process which actually goes on in the world as we know it. Aristotle seriously defended the belief. According to him not only are many insects directly generated by the decay of animal or vegetable matter (bugs, lice, and the like), but even the *testacea* are spontaneously developed out of mud and slime, and the same is even the case with some fishes (*H. A.* Z. 569ª 10 οἱ μὲν οὖν πλεῖστοι, ὥσπερ εἴρηται, τῶν ἰχθύων γίνονται ἐξ ὠῶν. οὐ μὴν ἀλλ' ἔνιοι καὶ ἐκ τῆς ἰλύος καὶ ἐκ τῆς ἄμμου γίνονται), and with eels, (ib. 570ª 6 τοῦτο ὅλον τὸ γένος τῶν ἐναίμων οὐ γίνεται οὔτ' ἐξ ὀχείας οὔτ' ἐξ ὠῶν). Thus he not only correctly denied that sexual procreation is the absolutely universal rule in the animal kingdom, but wrongly held that some members of it are actually developed out of non-living matter by thermal changes, a view based on misinterpretation of facts about putrefaction. The belief still persisted in the seventeenth century of our era (being accepted e. g. by Francis Bacon), and was only killed by the researches of Harvey.

92 c 4–9. καὶ δὴ καὶ τέλος . . . μονογενὴς ὤν. *Epilogue.* The formal declaration that our task of describing the structure of the αἰσθητὸς θεός, the visible living creature which embraces all other visible ζῷα, is completed.

92 c 5. θνητὰ καὶ ἀθάνατα ζῷα. The ἀθάνατα ζῷα are the heavenly bodies whose construction was long ago described.

92 c 7. εἰκὼν τοῦ νοητοῦ θεὸς αἰσθητός. A P and Stobaeus read ποιητοῦ for the νοητοῦ of F Y. Before the reading of F was known ποιητοῦ might have seemed the better attested text; as it is, the evidence is perhaps slightly in favour of νοητοῦ, though the occurrence of ποιητοῦ in Stobaeus suggests that the variant is older than any of our MSS. and possibly than their common source. In such a case we must be guided in our choice by the sense. Most editors have opted for νοητοῦ, but A.-H. actually prints ποιητοῦ, partly from a mistaken view about the transcendent authority of A, partly for a worse reason. He wishes to force on Plato the theory that the αὐτοζῷον which has repeatedly been called the παράδειγμα of the visible world, and the δημιουργός are really the same—in fact, to make the God of Timaeus a mere mythological symbol.

This is certainly not the theology of Plato, as we have *Laws* x to prove. It is made quite clear there that Plato's God is the supreme ψυχή, and therefore something quite different from the system of εἴδη. In fact, it is just the existence of the ἀρίστη ψυχή which enables Plato to bring the εἴδη into connexion with the visible and sensible world, and to escape from the difficulties about the relation of the intelligible to the sensible of which the *Parmenides* gives such a vivid description. (Cf. *Greek Philosophy, Thales to Plato,* 335–8.) Still, we must make a distinction which the editors in general forget. Can Plato, perhaps, have attributed this identification of God and εἴδη to Timaeus, without committing himself to it? I think the answer to the question must clearly

be *No.* An identification of the 'number-system' with God is not like anything we know of Pythagoreanism. What evidence we have goes to show that the Pythagorean religion was theistic, though the issues were naturally not defined as closely as they have been by two thousand five hundred years of reflection. It ought to be decisive that on the theory which A.-H. advocates the interpretation of the dialogue has, right up to its concluding sentence, been left ambiguous. It is a riddle, and it is only by one single word in its closing sentence that the key to the riddle is supplied. I do not think many students of Plato will agree that it is like him to construct a gigantic conundrum, to put his reader on a false track, to keep up the mystification for nearly eighty pages, and then to hint his real intention by one single word. A man with the fear of a supernaturally vigilant *Inquisitio de haeretica pravitate* before his eyes might be driven to such makeshifts, but Plato could have had no excuse for a mystification of this kind. If he really meant the δημιουργός and the αὐτοζῷον to be the same, we may be sure that he would have made the point clear early in the dialogue, but admittedly every word of it except the word ποιητοῦ, if that were the correct reading here, suggests not identity but distinction.

One may add that if Plato stooped to mystification, he was only too successful. The *Timaeus* was a widely-read and much-commented work in antiquity. We know a good deal, chiefly from Plutarch and Proclus, about the ancient traditional interpretations, and it is quite certain that subsequent Platonists down to the end always distinguished the αὐτοζῷον from the δημιουργός, even in their most fantastic theories about these beings.

What is worse, the interpretation and reading ruin one of the most important points in the whole dialogue. Timaeus began by setting the eternal (the ὄν) and the temporal (the γιγνόμενον) in sharp opposition. He then had to face the obvious problem *why* there should be any γιγνόμενον at all. Why should there not be just the eternal αὐτοζῷον? The δημιουργός was brought in expressly to provide the answer. There is the γιγνόμενον precisely because God is good, and goodness 'cannot be idle'. But if the δημιουργός is only the αὐτοζῷον over again, the gulf has not been bridged at all; we have the αὐτοζῷον and the world of mutability left standing over against one another, and T.'s pretended explanation of their connexion is an empty sham.

One might add one or two considerations which also make against accepting ποιητοῦ and are independent of theories about what is or is not Platonic doctrine. The very word ποιητής in the sense of a 'maker', 'artificer', is extremely unusual, so much so that it may be doubted whether Plato would be likely to use it in that sense without some defining condition. ποιητής *tout court* regularly means a 'poet', not a 'maker'. It is true that God has been called in this dialogue the ποιητὴς καὶ πατὴρ τοῦδε τοῦ παντός (28 c 3) and that we read in the *Republic* (x. 597 d 2) of him as κλίνης ποιητής, but the addition of the defining genitives makes all the difference.

So I think it is pretty clear that the author of *Timaeus Locrus* had the reading νοητοῦ in his text, and if so, this is probably by far the earliest

evidence we have for the sentence. He ends his paraphrase with the statement that the *οὐρανός* was made complete *ἐκ θεῶν τε καὶ ἀνθρώπων τῶν τε ἄλλων ζῴων, ὅσα δεδαμιούργαται ποτ' εἰκόνα τὰν ἀρίσταν εἴδεος ἀγενήτω καὶ αἰωνίω καὶ νοάτω*, where the closing words are a manifest paraphrase of *εἰκὼν τοῦ νοητοῦ*.[1] Philo of Alexandria is another author of the early first century A.D. who apparently read *εἰκὼν τοῦ νοητοῦ*, for he has (*Vit. Moysis* ii. 12 ad fin.) the phrase, used of the human species, *ἀντίμιμον γεγονὸς θεοῦ δυνάμεων, εἰκὼν τῆς ἀοράτου φύσεως ἐμφανής, ἀιδίου γενητή* (? *γεννητή*), where the words *εἰκὼν . . . φύσεως* are pretty clearly a reminiscence of the present passage.

In the third century of our era Plotinus clearly read *νοητοῦ*. Cf. *Enn.* vi. 2. 22 ad fin. *νοητοῦ τοίνυν εἰκὼν ἔχουσα ἐνδάλματα οὐ τοῦ πεποιηκότος ἀλλὰ τῶν περιεχομένων ἐν τῷ πεποιηκότι. οὐ τοῦ πεποιηκότος* could not have been written by any one who knew of *εἰκὼν τοῦ ποιητοῦ* as a variant in Plato's text, even if he preferred the other reading. I infer, then, that the change of *νοητοῦ* to *ποιητοῦ* is later than the time of Plotinus, i.e. it is not earlier than the fourth century A.D., if so early. The commentary of Proclus breaks off long before the end of the dialogue, but it is, I think, possible to be sure that the reading *ποιητοῦ* was unknown even in his time. For in his comments on the words *τῷ γὰρ τῶν νοουμένων καλλίστῳ . . . ἐντὸς ἔχον ἑαυτοῦ συνέστησεν* (30 d 1—31 a 1), Proclus relates that Atticus, in the second century A.D., had raised the question whether the *δημιουργός* himself is one of the *νοητὰ ζῷα* contained in the *παράδειγμα* or not. He proceeds (Diehl i. 431 ff.) to mention the various solutions of the question proposed by Porphyry, Amelius, and himself. They differ in various ways, but they all agree in taking it for granted that the *δημιουργός* and the *αὐτοζῷον* are not identical; the point at issue is which of the two is 'prior' to the other. If Proclus, or any of those who had discussed this question before him, had known of a reading *ποιητοῦ* in our passage, obviously the alternative that the *δημιουργός is* the *αὐτοζῷον* would have had to be faced. This suggests that the reading is actually later than the latter part of the fifth century A.D. Hence I think editors in general entirely right in retaining *νοητοῦ*, though until the text of F was known, there might have been a doubt whether *ποιητοῦ* had not the stronger MS. support. (Rivaud does not record anything about W.)

As to the construction, we must avoid the error of some translators and editors, who take *τοῦ νοητοῦ* to mean *τοῦ νοητοῦ θεοῦ*. This is hardly possible, since it requires us to 'supply' *θεοῦ* with *νοητοῦ* out of a word (*θεός*) which has not yet been employed. The real construction is indicated by the words *ζῷον ὁρατόν* in the preceding line. We must supply *ζῴου*, and the whole phrase means simply that the *κόσμος* is a 'visible living creature, embracing all other visible living creatures, which is an image of the intelligible living creature', i.e. a visible copy of the *αὐτοζῷον*, as we have all along been told.

As to the origin of the corruption one might reasonably suppose it not to be purely accidental. If it had been, one would naturally expect it to have been promptly put right by a *diorthotes*. Is it due to some *Christian*

[1] *καὶ νοάτῳ* seems to be wanting in T, but this is probably accidental.

copyist (or *diorthotes*) vaguely influenced by the story of God making Adam in His own image? Or may it not even be possible that ποιητοῦ was intended as the genitive of ποιητός? The mistake might conceivably be made by a Christian Platonist familiar with the theory of Philo Judaeus, expounded in his *de opificio Mundi*, that Genesis I describes the creation not of the sensible world but of the archetypes of sensible things, a theory adopted by Clement of Alexandria (*Stromat.* v. 93, Stählin, p. 387).

92 c 9. μονογενὴς ὤν. We must not attempt to extract from the words the doctrine that the αἰσθητὸς κόσμος *both* γίγνεται καὶ ἔστι, that it is at once 'eternal' and 'temporal', because everything recurs to infinity in successive cycles. T. has nowhere committed himself to the doctrine of those Pythagoreans who taught exact 'cyclical recurrence'. He has said no more than that all the astronomical motions have their periods. And he has expressly told us that the γιγνόμενον is precisely that which *never* ἔστι (γιγνόμενον μὲν ἀεί, ὂν δὲ οὐδέποτε), and that the actual *never* γίγνεται but is ὂν ἀεί, γένεσιν δὲ οὐκ ἔχον (27 d 6). To explain this antithesis away is to destroy the main point of his theory of φύσις, that 'passage' is the most fundamental character of 'Nature'. The ὤν has no existential force, and the words simply mean 'this one only-begotten οὐρανός'. It is interesting to remember that the best attested text in John i. 18 seems to be θεὸν οὐδεὶς ἑώρακεν πώποτε· μονογενὴς θεὸς ὁ ὢν εἰς τὸν κόλπον τοῦ πατρός, ἐκεῖνος ἐξηγήσατο. It is very hard not to suspect some, perhaps far-away, influence of our sentence in these words.

διατείνει δὲ ἀπὸ πέρατος εἰς πέρας εὐρώστως,
καὶ διοικεῖ τὰ πάντα χρηστῶς.

APPENDIXES

I. THE SPEECHES OF ERYXIMACHUS AND ARISTOPHANES IN THE *SYMPOSIUM*

a. Speech of Eryximachus (*Sympos.* 185 e 6—188 e 4).

Among the speeches in praise of Eros is one by the distinguished physician Eryximachus which is worth noting as a statement of the general position of the medical men who connected their science with cosmological theory. Its foundation is made up of two doctrines which we at once recognize as those of Alcmaeon of Crotona. (*a*) Most things in nature fall into pairs of 'opposites', a view which goes right back to Anaximander and is expressly ascribed to Alcmaeon by Aristotle (*Met.* A. 986ª 31, 'he says that most things in man's life, *τὰ πολλὰ τῶν ἀνθρωπίνων*, are pairs, meaning the pairs of opposites, *τὰς ἐναντιότητας*'. (*b*) The business of the 'professional' in general and of the physician in particular is to produce a good result by blending opposites in a *κρᾶσις* or *ἁρμονία*. This is just Alcmaeon's doctrine of *ἰσονομίη*, the 'balance of the constitution', since the result of an overplus of one member of such a pair is, by hypothesis, always bad. On these premisses E. proceeds to argue by adopting a distinction which had already been drawn between the good and the bad Eros. Eros means with him exactly what *φιλία* or *φιλότης* does with Empedocles, the attraction of unlike to unlike, the demand for everything to be completed by its opposite. The over-dry body thirsts for liquid, the overheated body demands 'the cool', and so on. On the strength of this theory, the good Eros is declared to be an attraction of *unlikes* which results in a duly balanced *κρᾶσις*, 'blend' or 'temperament'; the bad Eros is one which does not (*Sympos.* 188 a). Eryximachus begins by saying that the speakers before him seem to have forgotten that Eros is a cosmic principle or force, seen not only in human life (*ἐπὶ ταῖς ψυχαῖς τῶν ἀνθρώπων*, 186 a 3), but in all life, and indeed everywhere (*ἐν τοῖς ἄλλοις, τοῖς τε σώμασι τῶν πάντων ζῴων καὶ τοῖς ἐν τῇ γῇ φυομένοις, καὶ ὡς ἔπος εἰπεῖν ἐν πᾶσι τοῖς οὖσι*, ib. 186 a 5–7). Thus, to illustrate from his own profession, there is a *διπλοῦς Ἔρως* in our bodies; 'the healthy and the diseased in the body are confessedly different and unlike, and the unlike loves and desires the unlike' (186 b 5 *τὸ γὰρ ὑγιὲς τοῦ σώματος καὶ τὸ νοσοῦν ὁμολογουμένως ἕτερόν τε καὶ ἀνόμοιόν ἐστι, τὸ δὲ ἀνόμοιον ἀνομοίων ἐπιθυμεῖ καὶ ἐρᾷ*). So the 'love' felt by the healthy is different from that felt by the diseased, *ἄλλος μὲν οὖν ὁ ἐπὶ τῷ ὑγιεινῷ ἔρως, ἄλλος δὲ ὁ ἐπὶ τῷ νοσώδει*. (He means that e.g. the healthy body, when dry, desires drink, but only so much as will restore the 'balance' between 'the moist' and 'the dry'; the diseased body of an hydroptic or a man in a burning fever desires to be drenched with 'the moist' far beyond this limit, and that is why *crescit indulgens sibi dirus hydrops.*) The business of the physician is to comply with the good Eros of the healthy con-

stituents of the body, but to refuse to comply with the morbid Eros of the diseased (ib. 186 c). In fact, *ἰατρική* is just the scientific knowledge of the 'loves' of the body for filling and depletion (*ἐπιστήμη τῶν τοῦ σώματος ἐρωτικῶν πρὸς πλησμονὴν καὶ κένωσιν*, ib. c 6), and the true physician is the man who can distinguish the good from the bad Eros in this sphere and transmute them so that his patient acquires the first in place of the second, the man who knows how to produce Eros where it ought to exist but does not and to expel it where it exists but should not. 'For he must be able to make peace between the warring elements in the body and to make them in love with one another. Now the warring elements are the opposites (*τὰ ἐναντιώτατα*), cold—hot, sharp—sweet, dry—moist, and so forth' (ib. 186 d 6–e 1). Asclepius, *ὁ ἡμέτερος πρόγονος*, discovered how to instil *ἔρως* and *ὁμόνοια*, 'unity of heart and mind', into these opposites, and this is also the secret of such arts as agriculture, 'gymnastic' and music (ib. 186 e 4 ff.). (The jest is that the true physician is a scientific 'Sir Pandarus', the same jest which Socrates makes about himself in his capacity of *διαλεκτικός* in the *Theaetetus*.[1]) The true character of these arts is specially obvious in the case of music (the study which Pythagorean practice connected so closely with medicine). This is, perhaps, what Heraclitus meant when he said 'in being borne apart it is brought together', and in comparing the *ἁρμονία* in the world to that of a bow or a lyre. So long as the opposites remain asunder they do not form an *ἁρμονία*, a 'blend', at all, but when the high and the low, the long and the short, are brought into a proper ratio (an *ὁμολογία*), you get melody and rhythm. It is the business of music to produce this *ὁμολογία*, and so music, too, may be said to be 'a science of love affairs in the realm of melody and rhythm' (ib. 187 c 4). Now the musician has no difficulty in discriminating between the good and the bad Eros. (That is, the discerning of the fundamental intervals and the simple mathematical ratios on which they depend is a pretty easy business.) His real difficulty is to make men whose souls are not in tune (not *κόσμιαι*) for want of education (187 d 4–5) *prefer* the right melodies and rhythms, and this is like the physician's practical difficulty in making men relish the taste of wholesome food, so that they get the pleasures of palatable feeding without injuring their health (*ὥσπερ ἐν τῇ ἡμετέρᾳ τέχνῃ μέγα ἔργον ταῖς περὶ τὴν ὀψοποικὴν τέχνην ἐπιθυμίαις καλῶς χρῆσθαι, ὥστ' ἄνευ νόσου τὴν ἡδονὴν καρπώσασθαι*, 187 e 3).

We see the influence of Eros again in the 'weather', which is so important to the farmer. When the hot and cold, dry and moist, have an 'orderly love' (*κόσμιος ἔρως*) for one another, and exhibit a proper *ἁρμονία* and *κρᾶσις*, we get wholesome seasons for man, beast, and crops, but when the 'unbridled' Eros (*ὁ μετὰ τῆς ὕβρεως Ἔρως*) lords it over the weather, destruction and injustice follow (*διέφθειρέν τε πολλὰ καὶ ἠδίκησεν*, 188 a 8) in the forms of pestilence, drought, storm. (Cf. Anaximander, Theophr. *Phys.* Fr. 2, R.P. 16.) All these evils are due to 'usurpation and disorder' (*πλεονεξία* and *ἀκοσμία*) among the opposites. So the science

[1] *Theaet.* 149 d 5 *ἆρ' οὖν ἔτι καὶ τόδε αὐτῶν ἤσθησαι, ὅτι καὶ προμνήστριαί εἰσι δεινόταται*, 151 b 2 *ἐνίοις δὲ . . . γνοὺς ὅτι οὐδὲν ἐμοῦ δέονται, πάνυ εὐμενῶς προμνῶμαι.*

known as astronomy is another branch of the science of 'erotics' dealing with the revolutions of the heavenly bodies and the seasons of the year (188 b 5).

Astronomy is brought in because it is thought that the astronomer might be able to forecast the weather, and this knowledge is valuable both to the farmer and to the physician. So the writer of Hippocr. *περὶ ἀέρων, ὑδάτων, τόπων*, discoursing of the effect of topography and climate on physique says (§ 2, Kühlewein i. 34 ff.) that a physician, when he opens a practice, should make a careful study of the local winds, water supply, subsoil, and the 'orientation' of the city as well as of the habits of the population; *εἰ γὰρ ταῦτα εἰδείη τις καλῶς, μάλιστα μὲν πάντα, εἰ δὲ μὴ, τά γε πλεῖστα, οὐκ ἂν αὐτὸν λανθάνοι ἐς πόλιν ἀφικνεόμενον, ἧς ἂν ἄπειρος ᾖ, οὔτε νοσήματα ἐπιχώρια οὔτε τῶν κοινῶν ἡ φύσις, ὁκοίη τίς ἐστιν, κτλ.* A man who has mastered this knowledge may expect to be eminently successful in his medical practice. Some may think all this trifling (*μετεωρολόγα*), but the fact is that *οὐκ ἐλάχιστον μέρος συμβάλλεται ἀστρονομίη ἐς ἰητρικήν, ἀλλὰ πάνυ πλεῖστον*, because diseases vary with seasons and climate. This is the thought in the mind of Eryximachus. Owing to the general currency of 'geocentric' views, meteorology and climatology were not in the fifth century currently distinguished from astronomy; all are included in the study of *τὰ μετέωρα*, 'the things on high', and it is really climatology of which both Eryximachus and Hippocrates are thinking.

Divination and prophecy (*μαντική*) come under the same head as the rest of science. They deal with 'love affairs' between gods and men, and aim at fostering the right Eros and banishing the wrong in this sphere. *καὶ ἔστιν αὖ ἡ μαντικὴ φιλίας θεῶν καὶ ἀνθρώπων δημιουργὸς τῷ ἐπίστασθαι τὰ κατὰ ἀνθρώπους ἐρωτικά, ὅσα τείνει πρὸς θέμιν καὶ εὐσέβειαν* (*Sympos.* 188 c 7).

Thus the central thought of the speech is that not only medicine but all science and all religion depends on and aims at a proper 'equipoise' or 'blend' of opposites,—a generalization of the theory of health which goes back to Alcmaeon; the Pythagorean influence is shown in the elaborate parallel between medicine and music and in the turn given to the exegesis of the words of Heraclitus about the hidden *ἁρμονία*.[1]

b. The speech of Aristophanes (*Sympos.* 189 c 2—193 d 5).

The speech of Aristophanes in the *Symposium* seems to be generally gravely misunderstood. It is often taken as meant for a profound 'metaphysic of sexual love'. Now it is not very likely that Plato had the temperament which would dispose him to find the solution of the 'riddle of the universe' in sex; the author of the *Philebus* and *Laws* was assuredly no Schopenhauer, and all the 'erotics' of the dialogues profess to be given as illustrative of the temperament of the speakers. No one else in Plato talks of these matters in the strain appropriated to Socrates and

[1] What we might call the Empedoclean 'text' of this discourse is preserved in the lines (Empedocl. Fr. 17, R. P. 166):

καὶ Φιλότης ἐν τοῖσιν, ἴση μῆκός τε πλάτος τε·
τὴν σὺ νόῳ δέρκευ, μήδ' ὄμμασιν ἧσο τεθηπώς·
ἥτις καὶ θνητοῖσι νομίζεται ἔμφυτος ἁρθροις . . .

one or two of his friends. Still less is it likely that Plato would have selected Aristophanes, an Aristophanes who owns to having drunk too deeply the night before (176 b 4), and opens his discourse with a pointed reference to his calling as a professional 'funny man' (189 b 5–7), as the vehicle for profound speculations. We must look in another direction for the real object of his speech.

A. begins by saying—and so far he agrees with the earlier speakers, Eryximachus and Pausanias—that men in general do not adequately appreciate the greatness of Eros. This is shown by the fact that there is no public cult of him. (The words are probably meant to be a neat allusion to the passage in Euripides, *Hippolytus* 538–40 *Ἔρωτα δέ, τὸν τύραννον ἀνδρῶν, | τὸν τᾶς Ἀφροδίτας | φιλτάτων θαλάμων κληδοῦχον, οὐ σεβίζομεν.*) He goes on to illustrate the cosmical significance of Eros by a burlesque cosmogonical myth. The first men were circular and two-faced, with four arms and four legs. There were three sexes, if you can call them so, according as both the double bodies of one of these creatures were male, both female, or one male and the other female. But as yet there was no sexual impulse; human beings were begotten on and born from the soil, 'like *τέττιγες*' (191 c 1). These monsters were so strong and daring that they tried to overthrow the Olympians by storming heaven. Zeus was at his wits' ends, as he could not very well destroy the brood with his thunderbolts; that would cut off the supply of sacrifices and so, in the end, recoil on himself (190 c 4–5). (This touch is thoroughly Aristophanic and was probably suggested to Plato by the plot of the *Birds*, where the birds starve the Olympians into surrender by the device of a complete blockade which leaves Olympus without supplies.) At last Zeus had the happy thought of splitting the creatures in two. This would make them less dangerous, and, as Aristophanes characteristically adds, had the advantage of doubling the number of the sacrificers, and so increasing the revenue (190 d 2). At first, however, the consequences did not quite answer Zeus's purpose. The sundered halves went about looking for one another, and when they met, merely died in one another's arms. So Zeus turned round their faces on their trunks and gave them a new method of propagation to prevent the race from dying out—and the supplies of sacrifices from coming to an end. The anatomical changes necessitated are described, not with the dry medical precision of Timaeus, but in a spirit of Rabelaisian humour. The result of the whole is that the originally 'double' creatures have been cut in two like pickled sorb-berries, and each half goes wandering about seeking its mate. When they meet they long to grow together again and cling one another passionately. Their highest desire would be that Hephaestus would rivet them firmly into one creature. (Another deliberately broad comic touch.) This is what is called 'being in love'. If we are not careful, we may be split again, and then we shall be like reliefs on tombstones.

It is clear that this is simply a burlesque of a cosmogony which, like that of Timaeus, assumed that the differentiation of the sexes is not original but a 'product of evolution'. This is the very assumption made by Empedocles for the period of the world in which we are living, that in which *νεῖκος* is disintegrating the compact 'sphere'. The well-known

lines about the 'oxen with men's heads' and the bi-sexual creatures which lived early in this period but perished from inability to reproduce their kind are at the bottom of the stories of both Timaeus and Aristophanes. The only difference between the tone of the two speeches is that whereas Timaeus is quietly humorous in a decorous way, Aristophanes is Aristophanically boisterous in the fun he gets out of the idea.

The significant thing is that Plato assumes as a matter of course that Aristophanes is well acquainted with the speculations of a cosmological poet like Empedocles. As he shows himself in the *Clouds* familiar with Diogenes of Apollonia and his theory that 'air' is divine and is the same thing as νοῦς, probably he did know a reasonable amount about current 'scientific ideas'. How he would pick them up is sufficiently illustrated in the *Symposium* itself by his presence as a fellow-guest with Eryximachus. We should also compare with the speech in Plato the brilliant parody *Birds* 685–722, where the Chorus expounded a fanciful cosmogony of their own. According to them—they are consciously improving on Hesiod—at first there were Chaos, Night, Erebus, Tartarus, but not Earth or Sky (γῆ δ' οὐδ' ἀὴρ οὐδὲ οὐρανὸς ἦν, 694). (Thus Hesiod, who put Γῆ along with Chaos and Tartarus, Anaximenes, Diogenes, who begin with ἀήρ, and the usual Orphic cosmogonies which open with Γῆ and Οὐρανός are all wrong.) Night laid an egg out of which Eros came. (This looks like an allusion to the Orphic story of the cosmic egg which gave birth to Phanes, the first living creature, and it may be such an allusion if Lobeck was right about the antiquity of the 'Rhapsodic Theogony'. At any rate, Hesiod is again corrected, for he had put Ἔρος at the very beginning.) Then the birds were produced by Eros and Chaos, and only after that did Eros 'mix up all things' (*Birds* 700 πρότερον δ' οὐκ ἦν γένος ἀθανάτων, πρὶν Ἔρως ξυνέμειξεν ἅπαντα· | ξυμμιγνυμένων δ' ἑτέρων ἑτέροις γένετ' οὐρανὸς ὠκεανός τε | καὶ γῆ πάντων τε θεῶν μακάρων γένος ἄφθιτον.) (The 'mixing up' looks like a definite allusion to the 'sphere' of Empedocles. Cf. the κρατήρ of Timaeus.) It was only after the production of the birds that Earth and Sky and Ocean-stream, and their descendants, the gods, appeared. The birds thus claim, as against the gods, to be the 'elder branch'. 'Gods' are cadets, as the Stewarts were cadets of the Fitz-Alans. The whole thing is the work of a poet who has several mythical and scientific cosmologies in his mind and is treating them all as matter for burlesque. That the men of science are directly aimed at is shown by 690–2, where the Chorus profess to be telling the tale to explain the true facts about τὰ μετέωρα, 'things on high', i. e. the very things which had provoked the curiosity of the first Greek scientific inquirers and continued to be the main subject of their study until biology came into the forefront (ἵν' ἀκούσαντες πάντα παρ' ἡμῶν ὀρθῶς περὶ τῶν μετεώρων | . . . Προδίκῳ παρ' ἐμοῦ κλάειν εἴπητε τὸ λοιπόν).[1]

[1] The reference to Prodicus does not imply that he had any cosmological theory of his own. All that is implied is that in some of his lectures he retailed astronomical ideas about 'things on high'. The audience may 'tell Prodicus to go to Halifax' because, now that they have heard the truth about these things *gratis*, they have no occasion to pay his fees.

With what Aristophanes says in the *Symposium* about the different characters

II. THE *TIMAEUS LOCRUS*

The little work entitled Τιμαίῳ τῷ Λοκρῷ περὶ ψυχᾶς κόσμου καὶ φύσιος appears in a number of the inferior Platonic MSS., but has received scant attention from modern editors, though Bekker included a revised text in his edition of Plato, and there has been at least one later one, that of de Gelder (Leiden, 1836), containing unpublished conjectures of Valckenar. (I regret that I have not seen this work.) This neglect is unfortunate for a double reason. It is difficult to study the spurious 'Pythagorean' literature without being driven to the conclusion that its authors were often working with a substratum of genuine tradition, and that valuable suggestions may still be derived from some of them if we eliminate from their accounts of Pythagoreanism elements which can be shown to be derived from the Academy and from Aristotle. Moreover, even if the *Timaeus Locrus* proves to be valueless as a document for Pythagorean science, it is at least a summary of the physics, physiology, and psychology of our dialogue which is considerably older than any of the existing commentaries or MSS., and may thus have incidental importance both as showing what the state of Plato's text was long before the writing of our chief MSS. or even of their lost common archetype and as indicating an exegetical tradition which goes back beyond Chalcidius or Plotinus. The very mediocrity of the writer's mind is reason for thinking that no striking point in his interpretation is likely to be of his own invention. And, in fact, I have tried to show incidentally more than once that the evidence of the paraphrase to the text or its interpretation is really valuable. On the other hand, on one most important point, if my comments have been sound, the construction of the cosmic ἁρμονία of 35 b 4 ff., all the modern editors have gone astray precisely because they have followed the lead of Boeckh, who in his turn appears to have based his views on the statement of *Timaeus Locrus* 96 b–c about the sum of the terms of T.'s great double progression. They have supposed that the 'authority' behind them is that of August Boeckh, but in reality it is only that of whatever ancient interpreter supplied the unknown writer of

exhibited by mankind according as they are 'halves' of what was once a double male, or of a double female, or of a male-female, it is interesting to compare a passage of the Hippocratean περὶ διαίτης ᾱ (Kühn i. 650 ff.), where the writer accepts the Empedoclean theory that a child's body is composed of constituents from those of both parents in different proportions, and goes on ἢν μὲν οὖν ἄρσενα τὰ σώματα ἀποκριθέντα ἀμφοτέρων τύχῃ, αὔξεται κατὰ τὸ ὑπάρχον καὶ γίνονται οὗτοι ἄνδρες λαμπροὶ τὰς ψυχὰς καὶ τὸ σῶμα ἰσχυροί, ἢν μὴ ἀπὸ διαίτης βλαβῶσι τῆς ἔπειτα. ἢν δὲ τὸ μὲν ἀπὸ τοῦ ἀνδρὸς ἄρσεν ἀποκριθῇ, τὸ δὲ ἀπὸ τῆς γυναικὸς θῆλυ, καὶ ἐπικρατήσῃ τὸ ἄρσεν, ἢν μὲν τύχῃ, προσμίσγεται πρὸς τὴν ἰσχυροτέρην ἢ ἀσθενεστέρην . . . καὶ οὗτοι μὲν ἧσσον τῶν προτέρων λαμπροί, ὅμως δὲ διότι ἀπὸ τοῦ ἀνδρὸς τὸ ἄρσεν ἐκράτησεν, ἀνδρεῖοι γίνονται . . . ἢν δὲ ἀπὸ μὲν τῆς γυναικὸς ἄρσεν ἀποκριθῇ, ἀπὸ δὲ τοῦ ἀνδρὸς θῆλυ, κρατήσῃ δὲ τὸ ἄρσεν, αὔξεται τὸν αὐτὸν τρόπον τῷ προτέρῳ . . . γίνονται δὲ οὗτοι ἀνδρόγυνοι . . . τὸ δὲ θῆλυ γίνεται κατὰ τὸν αὐτὸν τρόπον. ἢν μὲν ἀπ' ἀμφοτέρων θῆλυ ἀποκριθῇ, θηλυκώτατα καὶ εὐφυέστατα γίνονται, ἢν δὲ τὸ μὲν ἀπὸ τῆς γυναικὸς θῆλυ, τὸ δὲ ἀπὸ τοῦ ἀνδρὸς ἄρσεν, κρατήσῃ δὲ τὸ θῆλυ, . . . θρασύτεραι μὲν τῶν πρόσθεν ὅμως δὲ κόσμιαι καὶ αὐταὶ (leg. αὗται). ἢν δ' ἦν (l. ᾖ) τὸ μὲν ἀπὸ τοῦ ἀνδρὸς θῆλυ, τὸ δ' ἀπὸ τῆς γυναικὸς ἄρσεν, κρατήσῃ δὲ τὸ θῆλυ . . . γίνονται τολμηρότεραι τῶν προτέρων καὶ ἀνδρεῖαι ὀνομάζονται. It is serious speculations of this kind about 'heredity' that Aristophanes it burlesquing.

Timaeus Locrus with his figures. (They are based on the assumption—96 b—that 384 is the integer from which the progression is to begin. Plutarch, *de Animae procreatione* 1020 c, tells us that this selection of the starting-point was given by Eudorus 'following Crantor' (ἐπακολουθήσας Κράντορι). It is not quite clear whether this means that Crantor had already given the whole series of terms of the progression, but I should suppose that the mention of Eudorus indicates that he had not; he had, perhaps, simply remarked that if we take 384 as our 'unit', all the terms of the series will be integers. Eudorus will be the 'authority' for the construction of the ἁρμονία given by Boeckh and followed implicitly by nineteenth-century editors.)

It seems worth while, then, to say something about the contents of this anonymous piece of exegesis. In its general character it is an epitome of the whole teaching of the dialogue from 27 d 5 to the end; i. e. it covers the ground of the discourse of Timaeus and merely disregards the dramatic setting of the dialogue and Critias's story of the pride and the fall of the Atlantid kings. We want, if we can, to discover the probable date and the probable standpoint of the author, and so to arrive at some conclusion about the sources from which he has derived his interpretations.

The external evidence is unluckily scanty. We can begin by fixing a terminus *ad quem* for the composition. We note at once that there is no recognizable allusion to it in Plutarch, nor does any author of Plutarch's age or an earlier refer to a work on cosmology by the Pythagorean Timaeus. On the other hand the work is mentioned by the Neo-Pythagorean Nicomachus of Gerasa in his tract on *Harmonics*.[1] As Apuleius, who appears to have translated the better-known *Introductio Arithmetica* of Nicomachus into Latin, belongs to the time of the Antonines, it follows that 'Timaeus' must at latest be a little earlier. Roughly we may say the work cannot be later than about the reign of Hadrian. But what about the terminus *a quo*? It is now generally admitted that the fabrication of works under the names of famous Pythagoreans goes back to the end of the second or beginning of the first century B.C., since the famous antiquary, M. Terentius Varro, appears already to have accepted 'Ocellus (or Occelus) Lucanus' as a genuine ancient document (Harder '*Ocellus Lucanus*' p. xiii.). If we could be sure that Plutarch means to ascribe the first attempt to give the terms of the ἁρμονία of the world-soul in detail to

[1] *Nicomachi Enchiridion* c. 11 (p. 260 in Jan's *Scriptores Musici Graeci*) where the writer professes to be following a method of constructing a system of tetrachords adopted not by Eratosthenes and Thrasylus, but by ὁ Λοκρὸς Τίμαιος ᾧ καὶ Πλάτων παρηκολούθησεν. This is according to him the genuine Pythagorean tradition for the 'section of the canon' for the interval 1–27, i. e. that specified in the *Psychogonia* of our dialogue. Though there is no actual quotation from our 'Timaeus Locrus', it is no doubt the work on the strength of which Nicomachus professes to know exactly how Pythagoras constructed an ἁρμονία of this compass. Unfortunately, though he promises to give the actual construction, the promise is not redeemed in what we possess of his work. In all probability he would have followed the indications of the *T. L.*; i. e. his ἁρμονία would have been that of Boeckh and his followers, though, if we may judge from the construction he gives for the double octave (Jan, pp. 258–9), he would have spoken in the loose Aristoxenian way of the intervals less than a tone as ἡμιτόνια.

Eudorus, and that he is right on this point, we could fix the date of *T. L.* a little more precisely, since Eudorus was a contemporary of Strabo and so belongs to the Augustan period. Hence if *T. L.* is really following Eudorus we could say that the work must have been composed not earlier than the Augustan age and not later than about the time of Hadrian, i.e. very roughly somewhere between 20 B.C. and A.D. 120. That we must not place it too early within these limits seems to be shown by the absence of any reference to it in Philo Judaeus. Now, if *T. L.* is really dependent on Eudorus, an interesting consequence follows. Eudorus of Alexandria was regarded as an Academic belonging to the group of successors of Antiochus of Ascalon, who made a sensation in philosophical circles by trying to read Stoicism into Plato, just as his contemporary Posidonius was reading Plato into Stoicism, and so gave the impulse to the composition of Cicero's *Academica*. (For the evidence about Eudorus in this connexion see Zeller[3] iii. 1. 611 ff.) The view of Antiochus and his followers was that there are none but verbal differences between Platonism and Aristotelianism, and that both at bottom are the same thing as Stoicism. This is the position expressly taken up by Varro, as the representative of Antiochus, in Cicero's *Academica Posteriora*. We should expect an abstract of the *Timaeus* coming from an adherent of this line of thought to translate the theories of T. into the familiar doctrines and terminology of the Peripatetics and at the same time to show a more or less strongly marked Stoic tincture. We should further expect that the earlier the date of the work within the limits assigned, the less marked would be any specific Neo-Pythagorean influence. In a work composed in the name of a Pythagorean after the time of Apollonius of Tyana, we should expect to find some traces, at any rate, of Apollonius; in a work belonging to a rather earlier period, e.g. the earlier part of the first century A.D., we might expect a pretty fair amount of echoing of Pythagorean catchwords, but we should look for the theology to be of the vague and eclectic monotheistic type which we get, for example, in Cicero. On the whole, I think, examination of the *T. L.* will show very strongly the tendency to treat T.'s doctrine as to all intents and purposes that of Aristotle, and will also show marked Stoic affinities, but of Neo-Pythagoreanism there do not seem to be any definite traces. Hence I should regard it as most probable that the composition dates from before the rise of Neo-Pythagoreanism, and should probably be assigned to some date well before the end of the first century A.D. In that case evidence as to the Platonic text, when it comes from *T. L.*, will obviously have to be taken very seriously. The interpretation may be expected to show signs of the eclectic *rapprochement* with Stoicism, and may possibly give us clues to the line taken in the commentaries of Posidonius.

To work out these points more in detail, *T. L.* opens his epitome by repeating the distinction of Plato's text between νοῦς or God and ἀνάγκη as causes of the world-order. He then resolves the 'universe' ξύμπαντα into three constituents, ἰδέα, ὕλα, αἰσθητόν. But he at once distinguishes ὕλα from sensible 'body', making it exactly equivalent to Aristotle's πρώτη ὕλη and saying that Plato 'calls' this πρώτη ὕλη 'place', τόπος or χώρα, exactly as Aristotle had said before him (94 a τὰν δ' ὕλαν ἐκ-

μαγεῖον καὶ ματέρα τιθάναν τε καὶ γεννατικὰν εἶμεν τᾶς τρίτας οὐσίας. . . . ταύταν δὲ τὰν ὕλαν ἀίδιον μὲν ἔφα, οὐ μὰν ἀκίνατον, ἀμόρφωτον δὲ καθ' αὑτὰν καὶ ἀσχημάτιστον . . . τὰν δὲ περὶ τὰ σώματα μεριστὰν εἶμεν καὶ τᾶς θατέρω φύσιος, where the distinction between a 'first' and a 'second' matter is simply obtruded on the dialogue from Aristotle).[1] So it is an Aristotelian gloss when we are told (94 b) that the meaning of the statement that *ὕλα* is perceived *νόθῳ λογισμῷ* is that it is thought not directly but *per analogiam* (*τῷ μήπω κατ' εὐθυωρίαν νοῆσθαι ἀλλὰ κατ' ἀναλογίαν*, 93 b). We note that the theology is theistic; there is no suspicion that *θεός* and *ἰδέα* may be meant for the same thing (*πρὶν ὧν ὡρανὸν γενέσθαι λόγῳ ἦστιν ἰδέα τε καὶ ὕλα καὶ ὁ θεὸς δαμιουργὸς τῶ βελτίονος*, 94 c. This is inevitable in a Peripatetic who must find room for the 'first mover' as well as for 'matter' and the 'forms' it receives). The *λόγῳ* has here been carefully interpolated with *γενέσθαι* in order to save Plato from all suspicion of heterodoxy on the doctrine of the eternity of the *κόσμος*. From the original Stoic point of view it was Aristotle who was heretical on the matter, but Boethus, Diogenes of Babylon, and Panaetius are all known or believed to have rejected the older Stoic doctrine of the periodical *ἐκπύρωσις* (Philo *de aeternitat. Mundi* 15, R. P. 526). *T. L.* thus reduces the part of the *δημιουργός*, as Plutarch does, to the establishment of order in what without him would be a chaos, but, unlike Plutarch, he does not believe that there ever was a time when things were actually chaotic. At 95 d the words about the soul of the world being a blend of the *ἀμέριστον* and the *μεριστόν* are given a Peripatetic sense by identifying the two with *εἶδος* and *ὕλη*, *κρᾶμα αὐτὰν κερασάμενος ἔκ τε τᾶς ἀμερίστω μορφᾶς καὶ τᾶς μεριστᾶς οὐσίας*; the *ταὐτόν* and *θάτερον* are reduced simply to two tendencies to motion (96 a) *ᾧ ποτέμιξε δύο δυνάμεις ἀρχὰς κινασίων, τᾶς τε ταὐτῶ καὶ τᾶς τῶ ἑτέρω*. This ought to create a difficulty, since one would expect that the *κινήσεις* mentioned are simply the 'diurnal' revolution and the motion of the sun and planets in the ecliptic. We should then further expect to find that the *δύναμις τᾶς ταὐτῶ κινάσιος* was given to one part of the cosmic *ψυχή*, that of the *κίνασις τῶ ἑτέρω* to another. But in the Platonic text the whole mass of which the two 'circles of the soul' are formed is homogeneous; *ταὐτόν* and *θάτερον* are commingled in every part of it before the construction of the two great circles is undertaken.

We may fairly suppose then that we are dealing with a popular exposition which does not really convey the meaning of the Platonic passage. The author goes on to describe the construction of the *ἁρμονία* in the *ψυχή*, remarking that if we start with the number 384 as the first term of the series the sum of all the terms is 114,695, a statement plainly copied from some fuller exposition, probably that of Eudorus, which gave the several terms of the series. We then get an exposition of the astronomy of the dialogue which conciliates it with Aristotelian and Stoic views by placing an unmoving earth at the centre of the cosmical system. The

[1] Bäumker (*Problem der Materie* 389) *may* be right in finding a trace of Stoic influence in the use of the word *οὐσία* at 94 a for the 'corporeal substances' perceived by our senses (*τὰν δ' ὕλαν ἐκμαγεῖον καὶ ματέρα τιθάναν τε καὶ γεννατικὰν εἶμεν τᾶς τρίτας οὐσίας*), but I do not feel convinced that this may not be a simple echo of the language of *Tim.* 35 a 2 about the *περὶ τὰ σώματα γιγνομένη μεριστὴ οὐσία*.

ἐναντία δύναμις of Mercury and Venus is apparently taken to refer simply to their alternating appearances as morning and evening stars (96 e—97 a). The writer goes on to refer to the 'spiral' of 39 a 6 and adds that it is made by the sun which moves one degree in the ecliptic for each daily revolution of the ἀπλανές (ποθέρπων μὲν κατὰ μίαν μοῖραν ἐν ἀμερησίῳ χρόνῳ, 97 c). Thus he keeps the old Pythagorean reckoning of the year as 360 days, 12 months of 30 days. No notice is taken of *Laws* viii. 828 a 7–b 3, where Plato's own reckoning of the year is given as 365 days. It is not clear that T. in the dialogue means to assert this old theory. According to Censorinus, who is supposed to be following Varro (see Diels *Fr. d. Vors.*[3] i. 297), Oenopides of Chios had reckoned the year at $365\frac{22}{59}$ days and Philolaus at $364\frac{1}{2}$ days (ib. i. 307). It is possible that these notices are not to be implicitly trusted, but it cannot be seriously doubted that the astronomers of the fifth century had made approximately correct computations of the length of the solar year. Timaeus nowhere mentions the number of days he allows to month and year, but in 39 c he defines the month and year without any reference to one another as the periods of moon and sun respectively, and the general tone of his remarks about the science of number as originating in the attempt to equate the periods of the various planets with diurnal revolutions of the 'same' suggest that he is well aware of the difficulty of adjusting the lunar and solar periods.[1] One may perhaps conjecture that in making his statements about the length of the month and year the writer of *T. L.*, or his authority, is deliberately 'archaizing' and overdoing it. The epitome proceeds to the geometrical construction of the regular solids, preserving what we know from Speusippus to be the genuine original names of the two types of elementary triangle, the ἀμιτρίγωνον (98 b) and ἀμιτετράγωνον (ib.). It rightly explains what was meant at 55 c 5 by the statement that God used the dodecahedron, ἐπὶ τὸ πᾶν, ἐκεῖνο διαζωγραφῶν by the comment τὸ δωδεκάεδρον εἰκόνα τοῦ παντὸς ἐστάσατο, ἔγγιστα σφαίρας ἐόν (*T. L.* 98 e). It then proceeds to explain how, since there is no 'void', things are always changing their places as 'the whole' revolves, and so the γενέσεις and φθοραί of all perishable complexes are brought about, and then returns to what Timaeus had said at an earlier stage about ἀναλογία as the bond which holds things together and the necessity that two mean terms should be inserted if the ἀναλογία is to have 'solids' for its first and last terms. What is said here is little more than a repetition of the actual words of the dialogue 31 b 4—32 c 4 in an abbreviated form, but another touch of correct old-Pythagorean colouring is added by the remark that as all the four constituents of the κόσμος are δυνάμει ἴσα, τοὶ λόγοι αὐτῶν ἐν ἰσονομίᾳ (Alcmaeon's word) ἐντί. Next follow some brief remarks about the sub-varieties of each of the 'roots' (99 c), which form a very inadequate summary of *Tim.* 58 c 5—61 c 2.

We now pass to the production of ζῷα θνατά, the passage about the making of the subordinate 'gods' being left unnoticed, presumably

[1] Cf. the mention (*Tim.* 47 a 5) of μῆνες καὶ ἐνιαυτῶν περίοδοι as provocative of thought, which would have little point in the mouth of a believer in the year of 360 days.

because the writer does not take it seriously. He says simply that after God had constructed the human soul on the same lines as the cosmic, he handed it over *τᾷ φύσει τᾷ ἀλλοιωτικᾷ*, 'to the mutable' (99 d).

His next remark finds no warrant in the text. The souls of the *θνατὰ ζῷα* are said to have been drawn partly from the sun and moon, partly from the other planets. But in the 'rational' part of the human soul, and in it only, the preponderant element comes from the *ἀπλανές* (99 e *τᾶς μὲν γὰρ ἀνθρωπίνας ψυχᾶς τὸ μὲν λογικόν ἐστι καὶ νοερόν, τὸ δ' ἄλογον καὶ ἄφρον. τῶ δὲ λογικῶ τὸ μὲν κρέσσον ἐκ τᾶς ταὐτῶ φύσιος· τὸ δὲ χέρειον ἐκ τᾶς τῶ ἑτέρω*). That the meaning is that the predominant constituent in the *λογικόν* comes from the *ἀπλανές* seems clear from the proceeding statement that the souls are drawn from all the circles *ἔξω μιᾶς τᾶς ταὐτῶ δυνάμιος ἂν ἐν τῷ λογικῷ μέρει ἔμιξεν*. This is manifestly a mere misunderstanding of the 'sowing' of the souls in the *ὄργανα χρόνου* spoken of by Timaeus. Presumably the source of the misinterpretation is chiefly a desire to find support for astrology in the dialogue by connecting differences of temperament with the planets under which men are born, while the Platonic principle that *ἀρετή* is *ἀδέσποτον* is saved by the theory that the 'better part' of the *λογικόν* comes from the *ἀπλανές*. If so we have here a definitely Stoic touch. Chalcidius (143–91, Wrobel pp. 203–36) shows the same anxiety to conciliate the utterances of the *Timaeus* and *Republic* with the Stoic conception of *εἱμαρμένη* and the acceptance of astrology and *μαντική*. Granting the doctrine of *εἱμαρμένη*, the erroneous exegesis of *Tim.* 41 e—42 e is seen to be an attempt to 'rationalize' the statements of Timaeus by eliminating the existence of *ἄνθρωποι* elsewhere than on the earth. This 'rationalizing' fits in with the subsequent explaining away of reincarnation. It is what we should expect in an exegesis mainly influenced by Peripatetic and Stoic ideas, but not in one seriously coloured by the revival of Pythagoreanism. I think a careful reading of the *T. L.* strongly suggests the view that the author is no Pythagorean at heart. His views are those of an eclectic of the time when Platonism, Aristotelianism, and Stoicism were being made out to be identical. This would suit the view that he is dependent for the main lines of his interpretation on Eudorus.

At 100 a we get the first instance of a piece of Pythagorean terminology which then recurs repeatedly. The soul is said to be the 'governor' (*ὕπατος*) of 'the whole booth' or 'tabernacle' (*τῶ σκάνεος ἅπαντος*).[1] The subsequent instances of the word are 101 c *τρέφεσθαι δὲ τὸ σκᾶνος τῶν ἐναερίων ζῴων κτλ.*, 101 e *διαιρωμένω τῶ σκάνεος ὑπὸ τῶ κενῶ*, 103 c *ἃ γὰρ φύσις οἷον ὄργανον ἁρμόξατο τὸ σκᾶνος*, 104 d *μετενδυομέναν τᾶν ψυχᾶν τῶν μὲν δειλῶν ἐς γυναικέα σκάνεα ποθ' ὕβριν ἐκδιδόμενα*. The origin of this designation of the body as the temporary 'booth' of the soul cannot be doubtful,

[1] Dr. Headlam says, commenting on Aeschylus *Agamemnon* 50 that 'in *T. L.* 100 a *ὡς τἄλλα μέρεα ὑπηρετεῖν τούτῳ καθάπερ ὑπάτῳ τῶ σκάνεος ἅπαντος*, translate it as you may, it will be seen that *ὑπάτῳ* is still superlative, and *τῶ σκάνεος* a partitive genitive'. I admit the possibility that *τῶ σκάνεος* here is partitive and depends on *τἄλλα μέρη*, but I hope I am not showing disrespect for Dr. Headlam's high authority in adding that since *ὕπατος* is the Greek for *consul*, I am not convinced that the rendering 'governor of the whole booth' is grammatically wrong in a work of the date to which *T. L.* must belong.

though the instances of it in earlier literature are very rare, except in the fragments of Democritus. I take the following collection of passages from *Fr. d. Vors.*[3] *Index*. Aelian *H. N.* xii. 17, Democritus said that untimely births are most common when the winds are southerly, *ἅτε τοίνυν τοῦ σκήνους διακεχυμένου καὶ οὐχ ἡρμοσμένου πλανᾶσθαι καὶ τὰ κυόμενα*, Democr. Fr. 223 *ὧν τὸ σκῆνος χρῄζει πᾶσι πάρεστιν εὐμαρέως ἄτερ μόχθου καὶ ταλιπωρίης, ὁκόσα δὲ μόχθου καὶ ταλαιπωρίης χρῄζει καὶ βίον ἀλγύνει, τούτων οὐκ ἰμείρεται τὸ σκῆνος, ἀλλ' ἡ τῆς γνώμης κακοθιγίη*, Fr. 37 *ὁ τὰ ψυχῆς ἀγαθὰ αἱρεόμενος τὰ θειότερα αἱρέεται· ὁ δὲ τὰ σκήνεος τὰ ἀνθρωπήια*, Fr. 187 *ψυχῆς μὲν γὰρ τελεότης σκήνεος μοχθηρίην ὀρθοῖ, σκήνεος δὲ ἰσχὺς ἄνευ λογισμοῦ ψυχὴν οὐδέν τι ἀμείνω τίθησιν*, Fr. 57 *κτηνέων μὲν εὐγένεια ἡ τοῦ σκήνεος εὐθένεια, ἀνθρώπων δὲ ἡ τοῦ ἤθεος εὐτροπίη*, Fr. 270 *οἰκέταισιν ὡς μέρεσι τοῦ σκήνεος χρῶ ἄλλῳ πρὸς ἄλλο*, Fr. 288 *νόσος οἴκου καὶ βίου γίνεται ὁκωσπερ καὶ σκήνεος*. The word is thus a favourite with Democritus, though the use cannot have originated with him. Only a believer in immortality, or at least in reincarnation, would naturally call the body in which the *ψυχή* resides its temporary 'tent'. Hence we are reasonably safe in inferring that the name originated among the Pythagoreans by whom Democritus notoriously was greatly influenced, and Bt. is likely to be right in connecting its use with the famous apologue of the 'three lives' ascribed to Pythagoras (*Greek Philosophy, Thales to Plato* 42). The reiteration of the word is manifestly an attempt at giving a superficial Pythagorean colouring to the discourse. One gets the impression that the writer only remembered the usage after he had got half-way through his work, and then set himself mechanically to repeat it as often as he decently could. The thought the phrase was coined to express means nothing to him.

A fairly full epitome is now given of the sense-physiology of the *T.* which is followed by a much abbreviated version of the theory of respiration and a fuller account of the pathology of the body and more particularly of the mind. The prominence given to disease of the mind and the cure for it, seems characteristically Stoic. We find substituted for T.'s subdivision of the genus *ἄνοια* into the two species *μανία* and *ἀμαθία* a rather different account. There are (102 d) many different disorders of the different 'faculties' (*ψυχᾶς νόσοι ἐντὶ πολλαί, ἄλλαι δ' ἄλλων δυναμίων ἐντί*). He then mentions the following *δυνάμεις* with their respective disorders:

αἰσθητικά—δυσαισθησία
μναμονικά—λάθα
ὁρμητικά—ἀνορεξία καὶ ἀπροπετία (? see below)
παθητικά—ἄγρια πάθεά τε καὶ λύσσαι οἰστρώδεες
λογικά—ἀμαθία καὶ ἐκφροσύνα.

Thus *ἀμαθία* and *ἄνοια* are made the species of disease, not of the soul in general, but of the *λογικὴ δύναμις*, and we are provided with four other *δυνάμεις*, of which Timaeus says nothing, each with its peculiar *νόσος* or *νόσοι*. We seem to be dealing with a doctrine that has undergone both Peripatetic and Stoic influences and yet is not strictly Peripatetic nor strictly Stoic. The language about the different *δυνάμεις*, especially the reference

to the ὁρμητικὴ δύναμις appears to be Stoic. According to the well-known Stoic view the μέρη of the soul are eight, the ἡγεμονικόν, the five αἰσθήσεις, the φωνητικόν, and the σπερματικόν (cf. Aetius *Placita* iv. 4. 4, *Doxogr. Graec.* 390 = R. P. 509, iv. 21. 2, *Doxogr. Graec.* 410 = R. P. 509 a). But it was apparently also held that each 'part' of the soul has one or more δυνάμεις to which it is the substrate (Iamblichus *de Anima* ap. Stobaeus *Ecl.* i. 367. 17 W., v. Arnim *Fragmenta Stoicorum* ii. 225 ἀλλὰ μὴν οἵ γε ἀπὸ Χρυσίππου καὶ Ζήνωνος φιλόσοφοι καὶ πάντες ὅσοι σῶμα τὴν ψυχὴν νοοῦσι τὰς μὲν δυνάμεις ὡς ἐν τῷ ὑποκειμένῳ ποιότητας συμβιβάζουσι, τὴν δὲ ψυχὴν ὡς οὐσίαν προϋποκειμένην ταῖς δυνάμεσι προτιθέασιν) Iamblichus *de Anima* ap. Stob. *Ecl.* i. 369. 6 W. [v. Arnim i. 39]. The δύναμις ὁρμητική and δύναμις λογική on this view belong to the μέρος called the ἡγεμονικόν; αἴσθησις, however, according to the view ascribed to Zeno and Chrysippus, should not be a δύναμις but should comprise five of the eight μέρη of the soul. (The difference between the μέρη and the δυνάμεις is that the former are physical parts of a physical thing, each occupying a different location in the body, the latter are 'qualities' of a substrate.) The substitution of a δύναμις αἰσθητική for the five αἰσθήσεις conceived as physical parts looks like an attempt at adaptation to the Peripatetic views about the αἰσθητικὴ ψυχή.

It is interesting, again, that the two disorders of the ὁρμητική should have the names given to them. ἀνορεξία plainly means a state of insufficient ὄρεξις, general lassitude. The word is only supported in L. and S. by two references, one to the present passage and one to the medical writer Aretaeus. The corresponding adjective ἀνόρεκτος is found in [Aristotle] *de Virtutibus et Vitiis* 1250^{a} 8, where σωφροσύνη is described as the ἀρετὴ τοῦ ἐπιθυμητικοῦ, καθ' ἣν ἀνόρεκτοι γίνονται τῶν περὶ τὰς ἀπολαύσεις τῶν φαύλων ἡδονῶν, 'unstimulated by the sordid pleasures of carnal enjoyment', and again at 1250^{b} 9 where it is similarly said that σωφροσύνης ἐστι . . . τὸ εἶναι πάσης ἀπολαυστικῆς αἰσχρᾶς ἡδονῆς ἀνόρεκτον. It occurs again in Plutarch *de cohibenda Ira* 460 b, where we are told that if we judge that a servant ought to be punished we ought not ἀφεῖναι τὴν κόλασιν ὥσπερ σιτίον ἀνορέκτους γεγονότας, 'as we decline food when we have no appetite for it'. The *de Virtutibus et Vitiis* is just such an attempt to combine Platonism and Peripateticism as we find in the *T. L.* itself, and it is interesting to note this coincidence in language. (Aristotle himself in his *Ethics* has a difficulty about finding a suitable name for the person who is not roused by stimuli which would appeal to the normal man, and has to fall back, with a kind of apology, on the word ἀναίσθητος, 'blockish', *E. N.* Γ. 1119^{a} 5.) By the first century A.D. a name had been found for these abnormally 'cold' persons, the name ἀνόρεκτοι. According to the published texts of *T. L.* the other disorder of the ὁρμητικὴ δύναμις is ἀπροπετία. I cannot believe that this is what the author intended. He manifestly meant the second 'disorder' to be antithetical to the first. No one talking of wrong states of the ὀρεκτικόν could possibly leave out of consideration the commonest of such states, undue readiness to snatch at any and every pleasure or to gratify any and every craving, the ἀκολασία of the *E. N.* Aristotle in Bk. Γ of the *Ethics* calls this disposition ἀκολασία, but as we advance further into the *Ethics* he finds that he wants the name ἀκολασία

for something worse,—the state of the man who is not merely very prone to offend against what he knows to be the 'right rule' from a strong propensity to the gratification of his passions, but deliberately and of set purpose follows a wrong rule. Hence at *Eth. N.* H. 1150b 19, undue propensity to follow the passion of the moment is classed as one of the two forms of 'moral weakness' (*ἀκρασία*), and gets the name *προπέτεια*, the fault meant being that of the man who surrenders himself 'passionately' and headlong to his mood as opposed to the other kind of 'moral weakness', *ἀσθένεια*, that of the man who makes good resolutions and tries to keep them but is always giving way, from mere lack of 'fibre'. The point is elaborately developed in the so-called *Magna Moralia* B. 1203a 30 ff. where the two forms of *ἀκρασία* are distinguished as *ἡ μὲν προτρεπτική τις καὶ ἀπρονόητος καὶ ἐξαίφνης γινομένη* and *ἡ ἑτέρα οἷον ἀσθενική τις, ἡ μετὰ τοῦ λόγου οὖσα τοῦ ἀποτρέποντος*, and the preference is given to the former, since it may be found even in a *σπουδαῖος* who is of a naturally 'warm' temperament, whereas sheer weakness of purpose and *σπουδαιότης* cannot coexist (*ὁ σπουδαῖος οὐδέποτε οὕτω γένοιτ' ἂν ἀκρατής*). It seems clear to me that this fault of headlong passion is what the *T. L.* refers to, and that we should re-examine the MSS. to make sure whether they do not read *προπέτεια* or *προπετία*. If they do not, the word should be restored by 'emendation'. (L. and S. regard *ἀπροπετία* as synonymous with *ἀπροπτωσία*, a Stoic word meaning 'deliberateness'. But 'deliberateness' could not be regarded as a 'disease' of the soul by a Stoic.)

One might perhaps detect a trace of Stoic influence in the stress twice laid on 'strength' of soul, once at 103 b and again when at 103 e the use of rebuke and chastisement is recommended by the remark *ῥωννύουσι γὰρ διὰ προτροπὰν ἐγείροισαι τὰν ὁρμάν*, but the inference would be precarious.

On the other hand the reproduction of the medical 'determinism' of T.'s account of 'disorders of the soul', unaccompanied by a single allusion to the other passages in which he insists on moral freedom and responsibility, is what we should expect in a writer under the influence of Stoic 'predestinationism'. The only qualification of the determinism of the *T. L.* is the insertion of the clause *ὅ τι μὴ ἀργία ἐστί*, 'apart from mere indolence', in the assertion that our parents and our bodily constitution are more to blame for our faults than we are ourselves (103 c). There is also a possible allusion to the Stoic theories about *τόνος* in the description of 'gymnastic', medicine, and philosophy as *δυνάμεις τρέφοισαι καὶ τονοῖσαι καὶ τὰ σώματα καὶ τὰς ψυχάς* (103 e). That we get an echo of the Pythagorean saying that philosophy is the highest music (*μωσικὰ δὲ καὶ ἁ ταύτας ἀγεμὼν φιλοσοφία*, 104 a) only shows that the writer or his source was well acquainted with the *Phaedo*. The dismissal of *τὰ καθ' Ἀιδεω* (104 d) and of 'transmigration' as useful fables is in keeping with the 'rationalizing' tone of the whole document, but ought to show that the Pythagoreanisms of the author are merely antiquarianism and do not represent convictions of his own. On the whole, it seems to me that a survey of the contents and language of the epitome justify the conclusions:

(*a*) That the work shows no Neo-Pythagorean influences and that its Pythagorean touches are simply borrowed from the writer's reading;

(*b*) That there is a Stoic influence shown chiefly by the recognition of astrology and the complete determinism;

(*c*) That for the rest, what we find in it is simply a harmonizing of Plato and Aristotle.

The natural inference is that the composition comes from an eclectic who regards Plato, Aristotle, and the Stoics as all having intended to teach the same thing. Since this fits in very well with what is known of the tendencies of Eudorus, whom the *T. L.* seems to be following in its statements about the cosmic ἁρμονία, the work is probably based on him and gives us a specimen of the interpretation of the *Timaeus* current among the reconcilers of Plato and Zeno, who begin with Antiochus of Ascalon. From the absence of any real evidence of Neo-Pythagorean influence, I should infer that it was probably composed in the first century A. D.

III. ARISTOTLE'S DOCTRINE OF SPACE

The immediate object of the present pages is strictly to give some account of Aristotle's views about space. I am not directly concerned with the wider question about the possibility of an actual infinite, since the alleged infinitude of space is here only one special case of the wider problem, which is discussed in the *Physics* (Γ. 4–8. 202^{b} 30—208^{a} 23) before we reach the consideration of space in particular, and determined on general grounds. Again, I am not primarily concerned with the more special discussion about the reality of an *empty* space (κενόν), which follows immediately on the discussion of 'place' (*Physics* Δ. 6–9. 213^{a} 12—217^{b} 28). The section of the *Physics* which directly concerns us is that which discusses the character of space itself, Δ. 1–5. 208^{a} 27—213^{a} 11. The first four books of the *Physics* form a single logical whole with a very simple principle of construction. The first book (as in the case of the *Metaphysics* and *de Anima*) is an historical retrospect of the views of others undertaken to determine the precise character of the object studied in the science, and so to discriminate it from other branches of 'theoretical philosophy'. The range of physics is settled by the consideration that its object 'Nature' is the complex of things which have a source of rest or motion internal to themselves, and of their constituent parts. Physics is the study of the ἀρχαί or αἴτια of the rest and movement of 'Nature'. The second book is therefore taken up with the distinction between the four senses of 'cause', the determination of the kind of cause for which the physicist is looking, and the discrimination of φύσις as an ἀρχὴ κινήσεως from τύχη and τὸ αὐτόματον, which simulate it. It is only when we reach Γ that we enter on an attempt to give a 'definition' of κίνησις, and to divide it into its constituent species. We have next to take note that the movements studied in physics are those of μεγέθη, *res extensae*, and that they occupy duration (ἔστιν ἡ περὶ φύσεως ἐπιστήμη περὶ μεγέθη καὶ κίνησιν καὶ χρόνον, Γ. 202^{b} 30); consequently it is part of the work of physics to discuss the nature of μεγέθη, time and space. The rest of Γ

is accordingly given up to arguments intended to show that no actual μέγεθος can be infinite and no trajectory nor duration infinite. In Δ we proceed to treat seriatim of (*a*) τόπος, (*b*) κενόν, (*c*) χρόνος. It is the discussion of τόπος with which we are specially concerned. The questions we are invited to consider are (*a*) whether it exists or not, (*b*) in what sense it exists, what is the modality of its being, i.e. to what category it is to be referred (πῶς ἐστί), (*c*) how it is to be defined (τί ἐστιν).

Question (*a*) is verily speedily disposed of. There certainly is such a thing as τόπος, for 'every one understands that things which are are *somewhere*' (τὰ γὰρ ὄντα πάντες ὑπολαμβάνουσι εἶναί που, Δ. 208ª 29), and 'what is non-existent is nowhere, for where is there a τραγέλαφος or a sphinx?' Simplicius regards this as an allusion to *Tim.* 52 b 2 ff. A second reason for holding that there certainly *is* τόπος is that τῆς κινήσεως ἡ κοινὴ μάλιστα καὶ κυριωτάτη, the κίνησις which underlies all other forms of change, is motion through space. The reality of this is guaranteed by αἴσθησις. (Movement is one of the κοινὰ αἰσθητά, along with σχῆμα, μέγεθος, ἀριθμός, *de Sensu* 437ª 9.)

Hence Aristotle promptly proceeds to question (*c*) τί ἐστιν, since on our answer to this will depend our answer to the remaining question πῶς ἐστί. τόπος *appears* to be something different from its filling, body. Where there is now water, by and by there may be air; the bodies are different but the 'place' they occupy is the same, much as though it were a kind of jug that can be filled at different times with different liquids. Hence 'place' is 'held to be' (εἶναι δοκεῖ) something different from any of the 'things which come to be in it and go through changes' (ὅτε δὲ τὸν αὐτὸν τόπον τοῦτον ἄλλο τι τῶν σωμάτων κατέχει, τοῦτο δὴ τῶν ἐγγινομένων καὶ μεταβαλλόντων ἕτερον πάντων εἶναι δοκεῖ· ἐν ᾧ γὰρ ἀήρ ἐστι νῦν, ὕδωρ ἐν τούτῳ πρότερον ἦν, ὥστε δῆλον ὡς ἦν ὁ τόπος τι καὶ ἡ χώρα ἕτερον ἀμφοῖν, εἰς ἣν καὶ ἐξ ἧς μετέβαλον, 208ᵇ 3–8). Here Aristotle is simply echoing *Tim.* 49 b 7–c 7, 50 e. He goes on, in virtue of his belief in an 'absolute' up and down, to ascribe a distinctive δύναμις or causal activity to the different regions of space, the up and the down, the right and the left, the before and behind, which he regards as the 'parts' of an 'absolute' space. 'For each (of the four kinds of body) is carried (φέρεται) to its own place, if left to itself (μὴ κωλυόμενον), one up and another down, but up and down and the rest of the six διαστάσεις are 'parts' or 'forms' (μέρη καὶ εἴδη) of place. These distinctions are not merely relative to ourselves (οὐ μόνον πρὸς ἡμᾶς), but there is a real distinction in nature (ἐν δὲ τῇ φύσει διώρισται χωρὶς ἕκαστον). It is not just any direction that is 'up', but the direction in which fire and light things move; similarly 'down' is not just any direction but that of heavy bodies and earth, so we see that the distinction is not merely one of position but of influence, (ὡς οὐ τῇ θέσει διαφέροντα μόνον ἀλλὰ καὶ τῇ δυνάμει, 208ᵇ 11–22). Aristotle, in fact, attributes to the different regions of 'absolute' space a sort of power of 'attracting' different kinds of body. It is odd that he does not see the inconsistency of his statement with the point on which he insists elsewhere that the vertical at one spot on the earth's surface is not the same direction as the vertical at any other. He is trying to combine the view of Timaeus that what we commonly call 'up' and 'down'

simply means 'from the centre to the circumference' and 'from the circumference to the centre' with a radically incompatible view that there is an 'absolute' up and an 'absolute' down. (I can hardly believe that Aristotle would have fallen into a blunder of this kind about facts with which he was perfectly acquainted except from an undue anxiety to disagree with the *Timaeus* wherever he can find an opening.) The question still remains *what* τόπος can be. It cannot be itself a body, since a body and the 'place' it fills have the same dimensions, and it would be absurd to say that two bodies can be 'in' the same dimensions at once. Again, if there is 'place' or 'room' of a body (σώματος τόπος καὶ χώρα), plainly there is also place of a surface and the other limits (i.e. the line and the point), for the same argument is applicable. Where there were formerly the planes (ἐπίπεδα) of the water, there will be by and by those of the air. (This seems to allude to the theory of T. on the composition of the four 'roots', the ἐπίπεδα of the water and air meaning the equilateral triangles which are the faces of their constituent particles). But we cannot draw any distinction between (οὐδεμίαν διαφορὰν ἔχομεν) a point and the place of a point. So if the place of the point is not different from the point, neither will the place of any of the others (sc. of a line, surface, solid) be different from them; the place of each will be nothing other than itself (209ᵃ 7–13). The object of this argument is to make us realize the difficulty of framing any theory of space by establishing an apparent dilemma. Either the τόπος of a body is itself a body, or it is something different from but correlated with the body. The first alternative we have just seen to be impossible; it is now suggested that the second is in the same case, and that there is no third alternative. The surfaces of a body must take up 'room', on this theory, as much as the body itself does, and so must its edges or bounding lines, and, by parity of reasoning, so must their points. If a body and its 'place' are distinct, a point (e.g. the apex of a pyramid of bronze) and its 'place' or 'position' must be distinct. The 'material point' must 'occupy' a 'geometrical point', whatever the precise meaning of 'occupation' may be. But a point *is* a position. We can draw no distinction between a point and the 'position occupied by a point', and consequently none between a body and the position it occupies. 'What on earth, then, can we assume place to be?' (τί γὰρ ἂν ποτε καὶ θείημεν εἶναι τὸν τόπον; 209ᵃ 13). 'Seeing what its character is, it can neither be a primary constituent (στοιχεῖον) ⟨of anything⟩, nor composed of such constituents (ἐκ στοιχείων), corporeal or incorporeal. It has magnitude but not body. But the primary constituents of bodies perceptible by sense are bodies, and, on the other hand, no magnitude is composed of primary constituents which are apprehended by thought' (ἐκ δὲ τῶν νοητῶν—sc. στοιχείων—οὐδὲν γίνεται μέγεθος, 209ᵃ 16–19). The argument is still conducted against the Academy and with an eye on the *Timaeus*. The *Timaeus* itself, it is meant, supposes the bodies we apprehend by our senses to be made of corpuscles which are bodies; as for the construction of these corpuscles out of something not apprehensible to sense, e.g. the triangles of Timaeus, or the 'numbers' of Plato and the Academy, we have seen already on what grounds Aristotle thinks this impossible.

There is a further difficulty; how can τόπος be a 'cause' of anything? That is, What does it explain? It is not the 'stuff' of which anything is made; it is not the characteristic 'form' or 'formula' (εἶδος καὶ λόγος) of anything; it is not the 'end' or state of completed growth in which anything culminates; it sets nothing moving. (This might look inconsistent with A.'s own former statement about the distinctive δυνάμεις of the διαστάσεις. Presumably the inconsistency is supposed to disappear when we remember that the movements of light things up and of heavy things down are 'natural', i. e. arise from an inner tendency within these bodies themselves.[1] They are conceived of as 'elective affinities' working from within, not as 'pulls' from outside.) Thus there seems to be no place for τόπος anywhere in the Aristotelian list of 'causes', and yet, if τόπος really is something, its existence ought to explain some of the appearances the world presents to us (209ª 18–22).

Again there is the old difficulty of the 'indefinite regress' urged by Zeno. If everything is 'somewhere', and τόπος is something, must we not ask where τόπος is? We seem to be led to an unending series of spaces of different orders, the space of order n being 'in' that of order $n+1$, and Aristotle always assumes that there can be no actually existing series with an 'infinite' number of terms (209ª 23–6).

Finally, it is urged, that if every body is in a place, it is also true that in every place there is a body (for Aristotle is assuming the point he will by and by set himself to prove, that there is no unoccupied space). Then what about growth? The 'place' occupied by a body is neither greater nor smaller than the body which occupies it. Must we say, then, that when the body grows bigger, its 'place' grows with it *pari passu*? (209ª 26–9).

Aristotle next goes on to develop what he regards as the subtlest difficulty of all. An equally good case may be made out for regarding τόπος as belonging to either the 'formal' or the 'material' constituent of that which is said to be 'in' it. The ἴδιος τόπος, 'place particular', of a given thing has nothing 'in' it but just that thing. Speaking loosely I may be said to be at this moment 'in' my house, 'in' Edinburgh, 'in' Scotland, 'in' the earth, 'in' the οὐρανός (this last word being used here in the Pythagorean sense for the ἔσχατος κύκλος). But properly I am 'in' that τόπος which contains my body and nothing else, and it is only in virtue of being in this ἴδιος τόπος that I can be said to be 'in' any κοινὸς τόπος which contain other things along with myself. This suggests at once a definition of 'place proper'. It is τὸ πρῶτον περιέχον τῶν σωμάτων ἕκαστον (209ᵇ 1), 'that which immediately encompasses a particular

[1] The tendency is a mere tendency. A 'simple body' does not move up or down unless it is already out of its 'proper place'. When it is in that place it simply stays there. The tendency only becomes actual in virtue of a displacement of the body, and this displacement is not initiated from within but from without. Without the efficient causality of the revolutions of the heavenly 'spheres', and in particular, without the obliquity of the Ecliptic (λοξὸς κύκλος), there would be no movement in the sublunary world and no γένεσις or φθορά of perishable things. (See *de Generatione* B. c. 10 with Mr. Joachim's *Commentary*.) This is how Aristotle reconciles the 'natural' motion of the simple bodies with the view that inanimate things can only be set moving from without.

body'. It thus appears to be a πέρας, a boundary. But the bounding surface of a thing gives it its form or shape. Thus τόπος would seem to belong to the side of 'form' in the analysis of a thing into form and matter (or, we may say, to the side of πέρας in the Pythagorean table of opposites; ὥστε δόξειεν ἂν τὸ εἶδος καὶ ἡ μορφὴ ἑκάστου ὁ τόπος εἶναι, ᾧ ὁρίζεται τὸ μέγεθος καὶ ἡ ὕλη τοῦ μεγέθους, 'the shape or form by which a *res extensa*, i.e. the matter of the *res extensa*, is determined'). But if you regard place, as you may also do, as the *dimension* (διάστημα) of the *res extensa* (i.e. if you look at it as so much *volume*), τόπος would seem to belong to the side of ὕλη (or, we may say, to that of ἄπειρον in the Pythagorean analysis). This 'matter' of the *res extensa* is different from the *res extensa* itself; it is τὸ περιεχόμενον ὑπὸ τοῦ εἴδους καὶ ὡρισμένον (209^b 7). That is, the shape of a sphere and a cube are different, but each may take up the same amount of 'room' as the other. When we speak thus, 'volume' appears as the indeterminate and formless *somewhat* which is given individuality by being determined as of this or that shape, ἔστι δὲ τοιοῦτον ἡ ὕλη καὶ τὸ ἀόριστον (209^b 9). For 'when abstraction is made of the boundary (τὸ πέρας) and the properties (πάθη) of the sphere, nothing but its matter is left'. By the 'matter' of μέγεθος, which is left when you have made abstraction of the shape of the enveloping surface, Aristotle does not mean matter in the Newtonian sense. The 'matter of the sphere' is just extension, volume, not as yet further particularized by any determination of shape, that of which we say there is the same amount in a cube of 1 c. ft. content as in a sphere of the same content. Hence Aristotle goes on at once (209^b 11) to say that both the account of χώρα in the *Timaeus* and the account given in the 'so-called ἄγραφα δόγματα' identify χώρα and ὕλη.[1]

The point, then, is this. In thinking about extension, you may think primarily of situation and figure; 'space' may be envisaged primarily as a network of relations of situation between certain ultimate elements. This is how it is studied, e.g., in pure descriptive or projective geometry. If you keep to this point of view, you will tend, Aristotle thinks, to the further identification of it with πέρας and εἶδος, the element of definite form and shape in bodies. Or you may think primarily of space as metrical, as that *of* which a given body occupies just so much. Your geometry will then be in the main interested in metrical properties, equalities, inequalities, ratios, and the like. If you follow this tendency to think primarily of space as metrical, you will be disposed to the further view that 'extension' is actually the 'stuff' out of which bodies are made by cutting it up into parts with different figures. And the discussion of the *Timaeus* is an example of the tendency. One may easily convince one's self of the reality of these divergent tendencies by asking in any company such a question as 'Do you think of a circle as a line or as an area?' I suppose we may say that in truth the tendency to think of situation and figure rather than of measurement is that of the *esprit juste*. For whereas you can build up a whole system of geometry without introducing metrical

[1] Strictly, Aristotle only asserts that Plato and Timaeus both treat χώρα as a 'determinable' (an ἄπειρον), not as a 'determinant' (a πέρας). Taken apart from any further implications, this is true.

ideas, you cannot construct a metrical geometry without non-metrical fundamental notions as well as metrical. (See B. Russell, *Principles of Mathematics*, i, chs. XLV–XLVII.) The thought of space as a network of relations between situations is thus *πρότερον τῇ φύσει*, but owing to the close connexion of geometry with the practical business of measurement in land-surveying, building, and the like, the other way of thinking is *ἡμῖν πρότερον*, as is shown by the predominantly metrical character of early Greek geometry and by the readiness with which most philosophers tend to think almost exclusively of metrical properties in their theories about space.

Aristotle's own view is that neither the identification of the *τόπος* of a body with its 'form', nor the identification with the 'matter' of the body can be defended. For the matter and form of a body cannot be actually separated from the body itself, but the 'place' of a body can be separated from it, since the same place may hold air and water alternately (*τὸ μὲν γὰρ εἶδος καὶ ἡ ὕλη οὐ χωρίζεται τοῦ πράγματος, τὸν δὲ τόπον ἐνδέχεται*, 209^{b} 22). You cannot take away the 'form' or the 'matter' from a thing and yet leave the thing standing. But you can move a thing from one *τόπος* to another without making any change in the thing. So, in respect of separability from the thing, its 'place' differs from its 'form'; again, the 'matter' is part of the thing, but the 'place' contains the thing, as a pail might contain water, without being part of the thing any more than the pail is part of the water (*ᾗ μὲν οὖν χωριστός ἐστι τοῦ πράγματος, ταύτῃ μὲν οὐκ ἔστι τὸ εἶδος· ᾗ δὲ περιέχει, ταύτῃ δ' ἕτερος τῆς ὕλης*, 209^{b} 30–2). To identify 'place' with either the 'form' or the 'matter' in things would also make nonsense of the doctrine that a 'heavy' or 'light' body may be out of its 'proper place'. If the *τόπος* of a thing is either its 'matter' or its 'form', it must be 'in' the thing, and so it would seem that it must move about as the thing moves. *τόπος* will thus change its own *τόπος*; there will be a second *τόπος* in which the first *τόπος* moves about (210^{a} 5–9). There is also a further difficulty suggested by the facts of change. When 'air turns to water', *τόπος* is lost, if *τόπος* is the same as either form or matter, but this perishing of *τόπος* is unthinkable. The exact meaning of this *ἀπορία* was disputed by the commentators, but Simplicius seems to me to have explained it correctly. When 'air turns into water'—when a gas is liquefied—what happens? Two things; the 'air' loses its distinctive character, or the gas its 'gaseous state'. This is a loss of the original 'form' and therefore would be a loss of *τόπος* if it were true that *τόπος* = *εἶδος*. Also, there is a change of volume; the liquid takes up less room than the gas had done. If, then, *τόπος* = *ὕλη*, it follows that there is less 'stuff' in the liquid than there was in the gas. But both these consequences are at variance with fact. *τόπος* is not destroyed by the 'change of state', though the body now takes up less of it than before, and therefore it is false that *τόπος* = *εἶδος*. And though the liquid fills less room than the gas, there is still the same amount of stuff, and therefore *τόπος* is clearly not the same thing as *ὕλη*.

Aristotle has now to pave the way for a theory of space which will enable us to escape from these difficulties. He begins (*Physics* Δ. 3.

210ª 14) in his usual way by making a series of verbal distinctions intended to save us from fallacies of amphibology. The word 'in' has a great variety of senses; it is important to be clear in which of these many senses we are using the word 'in' when we say that anything is in a τόπος. Ar. specifies seven uses of the word 'in' which are not that meant when we speak of a body as 'in a place'. (1) A part of any whole is 'in' that whole, as a finger may be said to be 'in' the hand to which it belongs; i.e. the relation is that of one constituent of a whole to the whole. (2) Again, the whole, in a different sense, is 'in' its constituent parts, for it is certainly not 'outside' them (*οὐ γάρ ἐστι παρὰ τὰ μέρη τὸ ὅλον*, 210ª 17). (3) 'In' may be used, in logic, of the relation of species to genus; the species man is 'in' the genus animal in the sense that it is part of the extension or comprehension of the genus; (4) Correlatively, from the point of view of intension, the genus is 'in' the species; the λόγος of the genus is part of the λόγος of the species. (5) Then there is a sense of *ἐν* in Greek which expresses real, as distinct from logical, dependence. One case of this real dependence is that conveyed when we say that *ὑγίεια* is *ἐν θερμοῖς καὶ ψυχροῖς*, i.e. 'depends on the hot and the cold'. The meaning is that health is a certain relation between the hot and cold constituents of the body, is, in fact, the equilibration of them. The 'hot and cold' are the 'matter' of health; the ratio of equality is its 'form'. Speaking generally, it is in this fifth sense that we say that the 'form' of anything is 'in' the corresponding matter, and not anywhere in an 'intelligible world' outside the matter. The form is a type of relation, and the form of a given thing is that relation subsisting between just these terms and no others. A relation of equality is not health unless the terms of the relation are the hot and cold constituents of a living body. (6) Another relation of real dependence signified by *ἐν* is the dependence of effects on their efficient cause. It is in this sense that we say that *ἐν βασιλεῖ τὰ τῶν Ἑλλήνων* (210ª 21), 'the fate of Hellas is in (the hands of) the Persian king', because he can initiate a policy which will determine what turn the affairs of Hellas are to take. (7) There is yet a third relation of real dependence expressed by this same proposition, *ὡς ἐν τῷ ἀγαθῷ καὶ ὅλως ὡς ἐν τῷ τέλει*, dependence on the final cause (210ª 22). The meaning seems to be that *qui veut la fin veut les moyens*; by willing the end we commit ourselves to will the means without which the end cannot be obtained.

All these senses of the word 'in' are derivative and metaphorical, whereas when we talk about a thing being 'in' a place, we are using the word *in* in its primary signification, just as when we speak of wine or water being in a pitcher, *πάντων δὲ κυριώτατον τὸ ὡς ἐν ἀγγείῳ καὶ ὅλως ἐν τόπῳ* (210ª 24). We must take care to keep this primary sense before us in constructing a theory of space and to ask exactly what is the relation we describe when we use the word *in* in this way and no other. It is particularly important to know whether any term can have the relation to itself (*ἀπορήσειε δ' ἄν τις, ἆρα καὶ αὐτό τι ἐν ἑαυτῷ ἐνδέχεται εἶναι, ἢ οὐθέν, ἀλλὰ πᾶν ἢ οὐδαμοῦ ἢ ἐν ἄλλῳ*, 210ª 25). The length at which Aristotle discusses this point, and the line on which he argues it are best explained by the view of Simplicius that he is covertly referring to the part played

by the question whether 'the One' or 'the Many' can or cannot be 'in itself' (or 'themselves') in the antinomies of the *Parmenides*. S. (ed. Diels i. 560) pertinently refers to *Parmenides* 133 a, 145 b. It is not necessary to follow Ar. into these minutiae; he decides that if 'in' be taken in the strict and primary sense, in which we speak of the wine as being in the bottle,—and this is the sense always meant when we say that a body is in a τόπος—'in' is strictly what is called by Schröder and other modern logicians an aliorelative. The terms of the relation are always two different terms. In the derivative sense which was mentioned first, both the wine and the bottle can be said to be 'in', i. e. to be constituents of, the complex, 'bottle of wine', but in the primary sense of 'in', the wine is in the bottle, but the wine is not in the wine nor the bottle in the bottle (ὅτι μὲν οὖν ἀδύνατον ἐν ἑαυτῷ τι εἶναι πρώτως, δῆλον, 210^{b} 21). As for Zeno's argument that if everything is 'in' something else, there must be a second space for space to be 'in', it may be dismissed as a fallacy of ambiguity. Things are in space, and space may also be 'in' something else, but in a different sense, one of the seven enumerated above, just as health is ἐν θερμοῖς ὡς ἕξις (it 'depends on' the proper adjustment of the θερμά to the other constituents of the body), and 'the hot', τὸ θερμόν is, in a different sense, 'in' bodies, ὡς πάθος (i. e. the relation in the second case falls under the category of διάθεσις, in the first under that of ἕξις). So Zeno's argument does not lead, as he supposed, to the indefinite regress (210^{b} 27). Thus we have finally disposed of the identification of the 'place' filled by a body either with the εἶδος or the ὕλη of that body. Both of these are constituents of the body in question (ἐκείνου γάρ τι ταῦτα τοῦ ἐνόντος, 210^{b} 30), but the 'place' in which a body is is not the body itself nor any constituent of it.

We now proceed to the positive construction of a theory of τόπος by starting from an enumeration of its ὑπάρχοντα καθ' αὑτό. Common sense assures us (*a*) that the τόπος of a body 'immediately embraces' that body (τὸν τόπον εἶναι πρῶτον μὲν περιέχον ἐκεῖνο οὗ τόπος ἐστί, 210^{b} 34), (*b*) that it is no part or constituent of that body (μηδὲν τοῦ πράγματος, 211^{a} 1), (*c*) that the 'primary' or 'proper' τόπος of a body is neither more nor less voluminous than the body itself (τὸν πρῶτον τόπον μήτ' ἐλάττω μήτε μείζω, 211^{a} 2), (*d*) that a 'place' and the body which it contains are separable (ἔτι ἀπολείπεσθαι ἑκάστου καὶ χωριστόν εἶναι, ib.), (*e*) that all 'place' exhibits the antithesis of up and down, and that the different bodies move naturally either 'up' or 'down' to their 'proper places' and rest when they get there (πάντα τόπον ἔχειν τὸ ἄνω καὶ κάτω, καὶ φέρεσθαι φύσει καὶ μένειν ἐν τοῖς οἰκείοις τόποις ἕκαστον τῶν σωμάτων, τοῦτο δὲ ποιεῖν ἢ ἄνω ἢ κάτω, 211^{a} 3.) It is clear that what is most prominent in Aristotle's own notion of space is the concept of 'voluminousness'. Situation is only mentioned in the unfortunate fifth statement about the ὑπάρχοντα καθ' αὑτό of τόπος. We can see already that τόπος will turn out to be 'volume with an up and down in it'. The idea is now worked out as follows. It is from *moving* things that we get our ideas about 'place'; if we knew nothing about movement there would be no problems about space to discuss (οὐκ ἂν ἐζητεῖτο ὁ τόπος, εἰ μὴ κίνησίς τις ἦν ἢ κατὰ τόπον, 211^{a} 12). Now motion may be absolute (καθ' αὑτό) or acci-

dental and 'relative' (*κατὰ συμβεβηκός*). And 'relative motion' may be that of something which is also capable of absolute motion, as of a limb of the body, or of the *ἦλος ἐν τῷ πλοίῳ* (211ª 20). (Aristotle's point is that as the body as a whole is conveyed from *A* to *B* each of its constituent *μόρια* is, of course, moved, and as the boat moves, the 'rivet' moves with it. But *his* theory of *τόπος* requires him to hold that, in these cases, because the *μόρια* of the body or the *ἦλοι* in the boat do not change their position relatively to the whole body or whole boat, the 'absolute' movement belongs to the body or boat as a whole, not to its constituents. They can only be said to be moving *improprie*, because a whole of which they are constituents is moving. *We* should say that if the motion of the whole body is 'absolute', that of every particle of it is absolute too, but Aristotle draws the distinction between 'absolute' and 'relative' motion differently.) In a looser sense, even subjects which are themselves not capable of absolute motion may have relative motion ascribed to them. For example, 'qualities' and 'states' cannot in the absolute sense move at all; only bodies can do so. But since 'pallor' (*λευκότης*) or 'science' (*ἐπιστήμη*) are, the one a *ποιότης* of myself, the other an *ἕξις* of myself, and I can move from place to place, my pallor or my learning may be loosely said to be where I am and to go where I go, *ταῦτα γὰρ οὕτω μεταβέβληκε τὸν τόπον, ὅτι ἐν ᾧ ὑπάρχουσι μεταβάλλει.* It is with motion *καθ' αὑτό* that we are now dealing. What do we mean when we speak of the moving body as being 'in' a place or leaving it? We have already laid it down that the 'primary place' of a body 'contains' that body, is no part of it, and is just equal in volume to it. It is now added that these postulates forbid us to regard any part of a continuum as being 'in' that continuum in the primary sense of the word. (The reason is that we had stipulated for a real distinction between container and contained. They must therefore not have a common surface.) It is when the surface of the contained is different from that of the container but yet everywhere in contact with it, that the container can be called the 'primary place' of the contained, and the contained be said to be *proprie*, 'in' the container. (*ὅταν μὲν οὖν μὴ διῃρημένον ᾖ τὸ περιέχον ἀλλὰ συνεχές, οὐχ ὡς ἐν τόπῳ λέγεται εἶναι ἐν ἐκείνῳ, ἀλλ' ὡς μέρος ἐν ὅλῳ· ὅταν δὲ διῃρημένον ᾖ καὶ ἁπτόμενον, ἐν πρώτῳ ἐστὶ τῷ ἐσχάτῳ τοῦ περιέχοντος . . . ἐν γὰρ τῷ αὐτῷ τὰ ἔσχατα τῶν ἁπτομένων*, 211ª 29–34.) Unless there is such a distinction of surfaces, *A* must be said to be moving *with* *B* (as part of *B*), not *in* *B* (*συνεχὲς μὲν ὂν οὐκ ἐν ἐκείνῳ κινεῖται ἀλλὰ μετ' ἐκείνου, διῃρημένον δὲ ἐν ἐκείνῳ*, 211ª 34). When I walk from one place to another, my hand moves *with* my body, but water carried in a cask really moves *in* the cask (211ᵇ 4). This consideration leads us to our definition of space or place, and also helps us to see how the various theories already dismissed as unsatisfactory have arisen. Space or place has been taken to be the form or 'figure' of the body which it contains, on the ground that it 'contains' just that body. What is true here is that both the place 'in' which a body is and the figure of the body are *πέρατα*, 'boundaries', but they are not boundaries of the same thing. The figure is the boundary (the outer surface) of the body itself, the 'place' is the boundary (the inner surface) of the body which 'contains' the first body

(*ἔστι μὲν οὖν ἄμφω πέρατα, ἀλλ' οὐ τοῦ αὐτοῦ, ἀλλὰ τὸ μὲν εἶδος τοῦ πράγματος, ὁ δὲ τόπος τοῦ περιέχοντος σώματος*, 211^{b} 12). Again, because the 'contained' can be removed while the container remains unmoved, it has been fancied that there is a gap or interval (*διάστημα*) between container and contained, and this interval has been supposed to be *τόπος*. But in reality there is no such gap; the surfaces of the two are everywhere in contact, though they are two and not one (*τὸ δ' οὐκ ἔστιν, ἀλλὰ τὸ τυχὸν ἐμπίπτει σῶμα τῶν μεθισταμένων καὶ ἅπτεσθαι πεφυκότων*, 211^{b} 18). The 'gap' theory, according to Aristotle, involves the consequences that there are *ἄπειροι τόποι* and that *τόπος* can change its *τόπος*, i.e. that there are an ascending series of orders of space (211^{b} 19–25). The meaning of the second argument is plain. On the 'gap' theory, when you carry a pail of water from one place to another, you must also be carrying about the gap or interval between pail and contents, so that you are transporting one 'space' through a second. The meaning of the other objection is not so clearly expressed, but since Aristotle goes on to insist that when we transport a vessel full of anything, the 'place of the whole changes, but not the 'places' of its parts (211^{b} 25 *οὐκ ἔστι δὲ ἄλλος τόπος ὁ τοῦ μορίου, ἐν ᾧ* [while] *κινεῖται, ὅταν ὅλον τὸ ἀγγεῖον μεθίστηται, ἀλλὰ ὁ αὐτός*), Simplicius seems right in explaining the reasoning thus. As you carry a bucket of water about, a rotation or a wave-movement is set up in the water. On the gap theory, every 'part' of the water has its own 'place', there is an interval between it and every other part, and the rotation or wave-movement will mean that each such particle is shifting from one of these gaps to another. Since matter is indefinitely divisible, the number of the 'intervals' will be infinite, however small the quantity of water in the vessel, and it will follow that, because it is a sum of an infinite series, the volume of a half-cyathus must be infinitely great! The explanation of Simplicius, correct or not, seems to explain Aristotle's refusal to admit that the parts of a continuous whole which is moving *καθ' αὑτό* are themselves also moving *καθ' αὑτά*, and his consequent denial that they are 'in' the whole in the primary sense of 'in', *ὡς ἐν τόπῳ*. Again, the reason why 'place' has been confused, as Ar. holds, by Plato with the 'matter' of bodies, is that the 'matter' of a thing may remain unchanged while its 'qualities' vary, just as 'place' remains unchanged while its contents vary. Ar. concludes that, when the three possibilities, that a thing's 'place' is a gap or interval, that it is the thing's figure, that it is its 'matter' have been excluded, only one possibility remains which satisfies all our initial postulates about the *ὑπάρχοντα καθ' αὑτό*. The place of a thing must be the (interior) surface or boundary of the body which immediately bounds it (*τὸ πέρας τοῦ περιέχοντος σώματος*, 212^{a} 5), and within which it can *move* (*λέγω δὲ τὸ περιεχόμενον σῶμα τὸ κινητὸν κατὰ φοράν*, ib. 6). This qualification embodies the demand already made that the containing and contained surfaces, though everywhere in contact, shall be really numerically distinct. 'Place' is thus, so to say, an unmoving receptacle, just as a receptacle might be called a movable place (*ἔστι δ' ὥσπερ τὸ ἀγγεῖον τόπος μεταφορητός, οὕτω καὶ ὁ τόπος ἀγγεῖον ἀμετακίνητον*, 212^{a} 14). Consequently, when a boat is going down a stream in which it is carried by a current, Ar. says it is the stream as a whole,

rather than the current, which should be called the 'place' in which the boat is contained (because the river as a whole looks more like something stationary, and *βούλεται ἀκίνητος εἶναι ὁ τόπος*). So finally the definition is that the 'place' of anything is 'the immediately contiguous unmoved boundary of the body containing it' (*τὸ τοῦ περιέχοντος πέρας ἀκίνητον πρῶτον*, 212ª 20). He adds that we now see why the 'centre' of things is 'down' and the 'inner' surface of the *οὐρανός* 'up'. The former is always unmoved, the latter, though it revolves, is uniform throughout and therefore as good as unmoving. The argument is that *τὸ μέσον*, the common centre of the earth and the universe, is strictly *ἀκίνητον κατὰ φοράν*, the surface of the 'sphere of the moon' which is turned towards us is invisible, and we do not see it move. Hence the 'centre' and this 'surface' are naturally taken as two opposed fixed *πέρατα* in between which things move, and we thus distinguish 'up' and 'down'. (*καὶ διὰ τοῦτο τὸ μέσον τοῦ οὐρανοῦ*—the 'centre'—*καὶ τὸ ἔσχατον τὸ πρὸς ἡμᾶς τῆς κύκλῳ φορᾶς*—the under surface of the *σεληνιακή*, the 'sky' of popular language—*δοκεῖ εἶναι τὸ μὲν ἄνω τὸ δὲ κάτω μάλιστα πᾶσι κυρίως, ὅτι τὸ μὲν ἀεὶ μένει, τοῦ δὲ κύκλου τὸ ἔσχατον ὡσαύτως ἔχον μένει*, 212ª 21.) As a matter of fact, the 'sphere of the moon' is not *ἀκίνητον*, nor is any other sphere. But we cannot see their revolutions; the 'sky' looks to us unmoved, and the 'centre' is unmoved, and thus the 'centre' and the 'sky' seem to determine the boundaries of the 'moved', and to constitute a *τόπος* answering to our postulates. It follows that the whole *οὐρανός*, as having nothing outside its circumference, does not properly 'occupy space' at all. It is only *κατὰ συμβεβηκός* that the *ἁπλανές* can be said to be *ἐν τόπῳ* (212ᵇ 12); its parts may be said *in a sense* (*πώς*) to be so, because any one of them is 'between' other parts, but as a whole, it is not *ἐν τόπῳ*.

What is to be said of this construction as a whole? Without going at length into the many debatable points of detail it presupposes, I take it every one who is not wedded to the utterances of the 'philosopher' must feel that it is unsatisfactory, as Simplicius, who appends an acute original examination of the problem to his exegesis of Aristotle, felt. And the reasons for the dissatisfaction are not hard to point out. Aristotle's views of space are predominantly metrical. He thinks of extension first and foremost as a 'quantity' of something, in fact as bulk, not as a complex of relations of situation. Cubic capacity, not direction, is the capital thing with him, and indeed one almost feels that he would have neglected situation altogether if 'absolute position' had not been demanded by his doctrine of the absolute lightness of fire. This is an unfortunate prejudice, for though it is quite possible to construct a body of geometry without introducing metrical considerations, it is quite impossible to construct a geometry on a purely metrical basis. Euclid's geometry, for instance, is predominantly metrical; it is mainly concerned with demonstrating propositions about the equality or inequality of lines, angles, areas, volumes. Yet Euclid absolutely requires e. g. the notion of 'similarly situated' figures and that of the opposition of senses on the straight line, and these notions cannot be metrically expressed. When he can, Euclid finds a metrical equivalent for a primarily non-metrical property, but no

such equivalent can be found for the opposition of sense or direction on the straight line, and this is accordingly taken for granted. Whether it is possible to pass from a purely non-metrical to a metrical geometry without the introduction of an additional new idea or ideas (distinctively metrical indefinables and postulates) or not, need not be discussed here, nor should I be competent to pronounce an opinion. But see the careful examination of the subject in Russell *Principles of Mathematics* XLVIII. 421–8. What does matter is that projective and descriptive geometry are coherent systems of interconnected truths requiring no metrical notions or postulates, whereas metrical geometry, in any case, cannot be completely developed without non-metrical ('projective') indefinables and postulates. Hence, in logical order, the notions of situation, direction, form are prior to the metrical notions employed in geometry.

Further, there seems to me to be a standing confusion in Aristotle's mind between two distinct questions, a fundamental and a merely secondary one, which naturally arises from this adoption of the purely metrical view about the science of geometry. The primary question is what volume is, what character does the word stand for? This is a question which any philosophical theory about space is bound to answer in one way or another. The secondary question is how we measure the volume of a given body, how much volume does it possess? I do not see that a philosopher need answer this question at all except by a reference to special works on solid geometry. I cannot help feeling that Aristotle's discussion of τόπος confuses these two distinct questions. His statement that the τόπος of a body is the surface of another body with which the first is anywhere in contact and in which it is contained may answer the question how great the volume of the contained body is, but I do not see that it throws any light on, or affords any analysis of, the concept of volume itself. I do not mean simply that Aristotle regards this concept as primitive and indefinable, as, indeed, it seems to be. We could not fairly dispute his right to select the indefinables of his own theory. The trouble, I feel, is that he seems to think that he is *describing* the character 'volume' when he is, in fact, telling us how to determine the magnitude of volume possessed by a given body.

There are further difficulties about the theory which it is easy to indicate. It follows, at once, from the definition assumed for τόπος that the whole οὐρανός has no τόπος, unless you say, with Dante, by a metaphor, that its τόπος is the mind of God.[1] If this only means that the question where the whole 'universe' is situated is nonsensical, we must admit the proposition, unless we accept both the ἄπειρον κενόν and the doctrine of 'absolute' position in the old Newtonian sense. But Aristotle's failure to make any distinction between the metrical and non-metrical properties of *res extensae* ought to lead to the further view, which he does not hold, that it is also meaningless to ask what is the volume of his own 'bounded

[1] *Paradiso* xxvii. 109:

> E questo cielo (*sc.* the first heaven) non ha altro dove
> Che la mente divina.

But here, of course, we are dealing with a 'catachrestic' sense of *ubi*.

universe'. If being ἐν τόπῳ and having a certain volume are the same thing (as the argument throughout assumes), the οὐρανός, not being ἐν τόπῳ, will have no volume. Yet it clearly has; if, as Aristotle holds, it is a sphere of finite radius.

Another obvious difficulty is raised by the conception of surfaces which are everywhere in contact and yet are two distinct surfaces. Aristotle's usual illustration is taken from the concave and convex surfaces of the sphere, or the concave and convex curvatures of the circle. But in this case it is one and the same surface or line which is under consideration, the difference being merely that it is seen in a different perspective. To say that two surfaces are *everywhere* in contact is only another way of saying that all their elements are identical; and thus they are not two surfaces but one. Aristotle's insistence on this notion leads to a very awkward cosmological difficulty. How are we to conceive of the concentric 'spheres' of his astronomy? If the innermost sphere of Saturn is at every point in contact with the outermost sphere of Jupiter, and yet the surfaces are two, then it follows at once that the 'fifth body', of which the 'heavens' are made, is not 'continuous', and this would be ruinous to the whole Aristotelian theology and cosmology. If, to escape this difficulty, you maintain, as Simplicius does in his commentary on the *de Caelo*, that all the 'spheres' extend 'down' to their common centre, which is also the centre of the earth, you have to believe that two bodies can be in the same place at once, since the 'fifth body' must then interpenetrate all 'elementary bodies'. Since Aristotle treats the view that two bodies can be ἐν ταὐτῷ as a patent absurdity (*Physics* Δ. 209^{a} 6) it is hard to believe that he meant to adopt it himself; presumably it had not occurred to him that his account of τόπος and his cosmology are inconsistent with one another.

The account of Timaeus seems to me much less open to objection. It has the advantage of not starting from metrical considerations. It is true that χώρα is called, among other metaphors, πάσης γενέσεως ὑποδοχή (49 a 5), and is said to be that 'in which' everything comes to be (49 e 7). But all through, no reference is made to cubic capacity or the like. What is primarily before the mind of Timaeus is simply the consideration that every physical event happens 'somewhere', and again that what happens *here* now is qualitatively different from what happens *here* by and by, and that, in virtue of these differences, χώρα receives different configurations (cf. 50 c 2 κινούμενόν τε καὶ διασχηματιζόμενον ὑπὸ τῶν εἰσιόντων). That is, χώρα is primarily not that of which bodies take up a greater or a less bulk, but that which exhibits different configurations and different 'sensible' properties in its different regions. Situation and figure,[1] not quantity, are made primary. 'Projective geometry' did not exist as a recognized science in the day of Timaeus nor in that of Plato, but it is on the 'projective', not on the 'metrical' properties of figures that Timaeus instinctively pitches as what calls for recognition when he introduces the notion of χώρα as a third requisite for his cosmology along with the παραδείγματα and their sensible μιμήματα. I have already explained

[1] Figure, that is, of the γιγόμενα. The πανδεχές is strictly ἄμορφον. Even 'projective' characters are characters not of 'space' but of complexes 'in' space.

why it seems to me a further great merit in his theory that he treats figure and situation throughout as in the first instance characters of 'events', not of bodies.

To put T.'s position as it might be expressed by a modern sympathizer who had the advantage of acquaintance with the works of Professor James Ward, if we mean by 'nature' that which is 'given' through our senses, nature is from first to last 'given' as a presentation-continuum of 'becoming', not in so many several parcels of 'things' or 'sense-data' *plus* relations 'between' them; the distinction of 'things' or 'data' within the whole of the given 'datum' is one which we only gradually learn to make, and there is always a great deal of arbitrariness in the precise way in which the lines are drawn at a given stage in the development of our knowledge. Spatial and temporal position and direction, like every other feature of nature, are primarily given to us as characters of the whole event which is nature. The business of theory is to make these characters better known to us, to enable us to pass from a mere 'acquaintance' with them which at the outset cannot strictly be called knowledge at all, though it is the necessary starting-point for knowledge, to an insight into their formal structure. It seems now to be fairly clear that nothing has done more to hinder such clear apprehension of the spatial-temporal structure of nature than the habitual isolation of space and time from one another, as if each could be understood without reference to the other. It has been assumed that the so-called 'order of coexistence' is intelligible without any reference to the 'order of succession'. The main *philosophical* interest of the Theory of Relativity seems to be that it is an attempt, forced by the progress of physics itself upon physicists with no preconceived metaphysical theories in their minds, to free us from hopeless perplexities created by this artificial separation of space and time and to return again to the conception of 'becoming' as presupposing not two distinct and different continua, space and time, but the one continuum of space-time. Timaeus, no doubt, formally treats of time and of space as distinct and different features of 'becoming' in different sections of his discourse. But owing to his freedom from metrical prepossessions, he gives an account of the ὑποδοχὴ γενέσεως, the 'continuum implied in becoming', which is such that it needs only to be supplemented by the recognition that the continuum has four dimensions and not only three to be still appropriate. (He himself does not say in his description of the ὑποδοχή what the number of its dimensions may be.) Aristotle's preoccupation with the notion of volume, on the other hand, leads to the traditional isolating of space from time with all the paradoxes it involves. This is why the latest philosophical work on the concepts of physics, work like Professor Whitehead's, strikes a reader familiar with Greek philosophy at once as an attempt to get back from Aristotelian positions to the general standpoint of Plato's Pythagorean cosmologist.

IV. THE CONCEPT OF TIME IN THE *TIMAEUS*.

A. *Time and Eternity.* The relation of time to eternity is made pretty clear in the dialogue, 37 c 6 ff. Temporality is a character which belongs universally and exclusively to τὸ γιγνόμενον, 'what is in the making', 'the unfinished', as contrasted with that which is once and for all all it can be, the 'eternal' (τὸ αἰώνιον). Time is thus connected with what Dr. Whitehead has called the 'passage' of nature. Time and events go together. Where there is nothing 'going on' there is not time. Hence time belongs to physical nature, because nature is just the complex of what is 'going on' (τὸ γιγνόμενον). Also, reasoning, choosing, feeling 'go on' or 'take place' though they are not *physical* events. Thus passage extends beyond nature; in some sense it belongs also to our inner life, though how the relation of our ψυχή to time differs from the relation of nature to time is a difficult question which no one has yet adequately cleared up. On the other hand, to intelligence (νοῦς) as such, 'passage' does not apply (as the great poets have always felt). It is clear that when we draw the fundamental distinction between the intelligence which knows and the objects of its knowledge, all relations of before and after are relations between parts discriminated in the object known, not between the object and that which knows it. This is why an intelligent mind (a ψυχή in which, as Plato puts it, there is νοῦς), is, so to say, a mediator between time and eternity. It is on the confines of both and has a foot in each. The Neo-Platonists formally expressed this by saying that the being (οὐσία) of the ψυχή is eternal, but all its activities temporal, whereas both the being and activities of νοῦς are eternal, those of physical nature both temporal. This gives rise to a difficulty. God, as we have seen, is, according to Plato's *Laws*, a ψυχή, and God ought thus to be related to time in the same way in which our souls are. But in the *Timaeus* the Demiurge (i. e. God) actually 'makes' both ψυχαί and time. It ought to follow that God is not a ψυχή and His activities not temporal, if the account of Timaeus really means anything. Plato leaves the problem unsolved, and it is interesting that Bt., who rightly lays stress on the supreme importance of Plato's doctrine of God, apparently does not see that there is any problem. The Neo-Platonists were alive to it, and in their version of Platonism definitely followed the lead of Timaeus. They teach that above the place of ψυχή in the hierarchy of being comes νοῦς, and above νοῦς itself stands the supreme One of which we may not even say that it 'is' or 'is eternal'. They call it προαιώνιον 'pre-eternal' and ὑπερούσιον 'supersubstantial' or 'superessential'. It is not to be called a being though all being issues from it. The immediate source in Plato for all this is the famous passage of the *Republic* about the Good, which is declared to be 'on the other side' of being (*Rep.* 509 b 9). Neo-Platonism thus definitely made the supreme God identical with the Good. Since in the *Timaeus* the Creator is plainly distinguished from the Good (which inspires His activity), Proclus explains that the Creator is νοῦς, which proceeds immediately from the Good. Then he has to reconcile this with Plato's repeated insistence that νοῦς exists only in

a ψυχή and that it is the ἀριστὴ ψυχή which causes the orderly motions of the heavens, by arguing that there are really two Creators, a higher and a lower. But there is no hint of any part of this theosophy in Plato. There is a real difficulty in his teaching about God, but he has left it standing.

What is clear is that we must not think of eternity as endlessly prolonged succession without a beginning. That would be just time over again, the 'passing' of an endless series of events, and Timaeus tells us that 'passage' belongs only to what 'becomes'. Such succession, though endless, is only the 'moving image of eternity'; it is not eternity itself. There are interesting attempts, inspired by Neo-Platonism, in the scholasticism of the Middle Ages to work out a doctrine much on these lines. St. Thomas, for example, regards *aeternitas* as the mode of being of one to whom everything is *totum simul*, the whole passage of nature being apprehended as a single fact. Such eternity he regards as peculiar to God. The mode of being of created intelligences is neither *tempus* nor *aeternitas* but what St. Thomas calls *aevum*. His words on the matter are,[1] 'since eternity is the measure of abiding being, in so far as anything falls short of permanence of being it falls short of eternity. But some things fall short of permanent being because their being is subject to transmutation or consists in transmutation. Things of this kind are measured by time, e. g. all motion and the very being of all corruptible things. But other things fall less short of permanent being because their being neither consists in nor is subject to transmutation; still they have transmutation added as a complement to it, either in act or in potentiality, as we see clearly in the case of the heavenly bodies. Their substantial being is not transmutable [this is Aristotle's false cosmology], but they possess a non-transmutable being along with transmutability of position. Likewise, we see this clearly in the Angels, viz., that they have non-transmutable being along with transmutability according to election [i. e. some of them elected to rebel and were reprobated, others to stand fast and received higher grace as a reward], and along with transmutability of understanding, feeling, and place in their proper mode. Accordingly, things of this kind are measured by *aevum*, which is intermediate between eternity and time. The being which eternity measures is neither mutable nor conjoined with mutability. Thus time has before and after, but *aevum* has not before and after in itself, though they can be conjoined with it. Eternity has neither before and after nor does it permit of them.' This is manifestly the Neo-Platonic doctrine applied to Christian theology.[2] For an elucidation of this conception of *aevum* in modern language I must be content with a reference to Baron F. von

[1] *Summa Theologiae, Pars Prima, Quaestio* x, *Art.* 5.

[2] The acknowledged starting-point of the doctrine is the famous definition of Boethius (*de Consolat.* v, Prosa 6) that *aeternitas* is *interminabilis vitae tota simul et perfecta possessio*, 'Eternitie thanne is parfit possession and altogidre of lif interminable', as Chaucer renders it. Hence 'thilke thing that suffreth temporal condicioun, althoughe that it nevere bygan to be, ne thoughe it nevere cese for to be, as Aristotile demed of the world, and althoughe that the lif of it be strecchid with infinitie of time; yit algatis his it not wich thing that men mighten trowen by ryghte that it is eterne'. So Milton, 'Then long Eternity shall greet our bliss | With an *individual* kiss'.

Hügel's striking work *Eternal Life*. (For St. Thomas in particular see c. vii of that work.)

Next, note carefully that χρόνος is not the same thing as the fundamental 'passage' of nature, the fact that nature is 'what goes on'. The name for this passage in Plato and Aristotle is κίνησις, which covers not only change of position (motion in our sense of the word), but change in size or quality, or when the word κίνησις is loosely used, actual coming to be (γένεσις) and ceasing to be (φθορά), though when Aristotle wishes to be exact he calls γένεσις and φθορά not κινήσεις but μεταβολαί, and makes κίνησις a subspecies of μεταβολή, 'mutation of something which already is'. Plato, as we have seen, expressly reckons the 'motions' of ψυχή, thoughts, feelings, volitions, as κινήσεις and the origin of all other κίνησις. Time, according to both Plato and Aristotle, is not the 'passage' itself, but the 'measure' (μέτρον) or 'number' (ἀριθμός) of κίνησις. In any specification of the time that has elapsed we are *comparing* examples of the 'passage' of nature. For example, when we say 'his illness lasted three days', we compare one event (the illness) with another (the return of sunrise or noon).

Plato and Aristotle know nothing of Kant's doctrine of the 'ideality' or 'subjectivity' of time. They regard the world which appears not as an 'effect' on our minds of an unperceived world of non-sensible causes, but as the actual physical world itself. Consequently the temporal and spatial relations between things and events are rightly regarded by them as real relations between the things, not as relations somehow imposed on them by the percipient mind. It was Kant's misfortune that he took the other view.[1] *His* theory of space and time leads to the same sort of fatal misunderstanding of the character of physical science as the older error of separating 'primary' qualities, thought of as real whether we perceive them or not, from 'secondary'. For a brilliant exposure of the fallacy which lies at the root of both theories, see Whitehead *The Concept of Nature* Lecture II (Theories of the Bifurcation of Nature). But Kant's version of the 'bifurcation' fallacy leads to a much more complete scepticism than the older version of Galileo, Descartes, and Locke. They at least believed that the spatial, temporal, and mechanical relations we perceive 'correspond to' the same relations among the 'realities'; Kant holds that everything we perceive is *mere* appearance, and that of real things we only know this much, that they are the unknown causes of the illusion we call nature. Plato and Aristotle know nothing of these 'bifurcation' theories (though, no doubt, Aristotle's demand for the mysterious 'substrate' of 'becoming' which he calls ὕλη gave an impulse to the development of such views). They identify the Nature of which physical science investigates the laws with the complex of perceived processes, as men of science are at last learning to do again, and hold that the spatial and temporal relations between things are part of what we perceive (belong to the *perceptum*, not to the *percipiens*). On the importance of distinguishing relations between parts of the perceived object from relations of that object—Nature—as a whole to the percipient and the

[1] On the hopeless confusion in which Kant has left the doctrine of Time see the excellent treatment of H. A. Prichard, *Kant's Theory of Knowledge* ch. 5.

inextricable perplexities to which any confusion between the two relations leads, see in particular the admirable and too little studied work of J. Grote *Exploratio Philosophica* c. 1.

B. *Absolute and Relativist Theories of Time and Space.*

The most important difference between philosophical theories of space and time is the difference between the absolute and the relativist or relational theories. In the history of modern speculation, Newton is the most illustrious representative of the one type of view, Leibniz of the other. The question is whether 'absolute' position in space or date in time means anything or not. If we are asked where such and such a thing is or when such and such an event happened, the answer is always given by a statement which comes to saying that the thing is 'so far and in such a direction' from something else, the event happened so many days or months or years before or after some other event. The relational doctrine maintains that this is all that a statement about a position or date can possibly *mean*. Such a statement tells you how far and in what direction (in space or time) *a* lies from *b*. If you go on to ask 'but where or when is *b*?' you are similarly told how far and in what direction *b* is from *c*, and so on without end. The reason is that relations of distance and direction are not relations between points of 'empty' space or instants of 'empty' time; they are relations between the events which are said to be in space and time. There are no *things* called space and time. The relations in question are therefore neither relations of 'places' and 'times' to one another nor relations of the things which 'fill' space and time to the places and dates which they fill. They are direct relations of one event to another, and this is why we can only say where one thing is by saying how you get to it from some other thing, or when one event happened by saying how long it was before or after some other. Space and time are thus just the network of all relations of position between things and events. This is the relativist view summed up by Leibniz in his dictum that space is the order of co-existences, time the order of succession.

Newton, if the language of the *Principia* is to be pressed, took the other view. He looks on space and time not as systems of relations between particles or events but as a framework into which particles and events are fitted, though so far as the nature of the framework goes, it could equally well exist 'empty', without the filling. It follows that a distance is not a direct relation between two particles or two events themselves, but a relation between the 'points' of space or time *at* which the particles or events are. The particle or event which is *at* the place or date has then a *further* peculiar relation to the place or date at which it is; it 'occupies' it. Relations of distance are thus primarily relations between places or dates themselves, and they only hold between particles or events in a secondary way because they already connect the places or dates those particles or events 'occupy'[1]. This is the theory which *seems*

[1] See the clear expositions of the difference between the two types of theory in B. Russell *Principles of Mathematics* i, chs. LI, LVIII, stating the 'Newtonian' standpoint, and in C. D. Broad *Scientific Thought*, chs. 1-3.

to be implied and is usually held by its supporters to be implied in Newton's famous *Scholium* to the definitions at the beginning of the *Principia*. 'Absolute, true, and mathematical time, in itself, and its own nature, apart from relation to anything else, flows equably and is also called duration; relative, apparent, or vulgar time is any sensible and external measure of duration by motion (whether exact or uneven) which the vulgar use in place of true time, as, an hour, a day, a month, a year.' 'Absolute space, in its own nature apart from relation to anything else, always remains homogeneous (*similare*) and immovable; relative space is any movable measure or dimension of this absolute space . . . and is used by the vulgar instead of immovable space, e.g. the dimension of a subterranean, atmospheric, or celestial space defined by its situation relative to the Earth.'

It is a consequence of the relativist theory that motion, 'change of position', is also as purely relative as position. If you were standing on the sun, since the relative positions of the two bodies are all that are altered by the annual 'revolution' you will be describing what happens quite accurately if you state it as you see it, 'the earth is going round the sun'. But equally, if being on the earth, you state what you see by saying 'the sun is going round the earth', this is also a correct statement. The one and only thing that has happened, the relative change in the positions of the two bodies, is described equally correctly in both cases, but from a different standpoint in each. To ask 'but which of the two bodies is *really* moving?' is to ask an unmeaning question, for, on the relativist view, to be 'really moving' means nothing unless you say relatively to *what* other body the moving body is changing its position. The sun really is changing position relatively to the earth, the earth relatively to the sun, and therefore each can be said to be moving relatively to the other. To ask about a real motion which is not change of position relative to some *body* is as meaningless as to ask 'Is 5 greater?' 'Is a right angle less?' (This is so, because on this theory, since relations of distance are relations between bodies or events, there are no relations of a body or an event to a place or a time.)

At first sight the relativist theory seems to have obvious advantages, and this, no doubt, is why most modern metaphysicians from Descartes on have favoured it. *We* at any rate can only distinguish *relative* positions. If there are such things as 'absolute' places and dates, at any rate we are never acquainted with them. I know how far London is from Edinburgh and in what direction. But neither I nor any one else can answer the question where London is in 'absolute space'; what its 'absolute position' is, if it has such a thing, none of us can tell. So it may seem superfluous to believe in something of which, from the nature of the case, we can have no knowledge whatever. If relative positions are the only positions of which we can ever know anything, what use is there in encumbering science with a belief in purely unknown 'absolute' positions?[1] Newton was not the man to believe in a gratuitous absurdity.

[1] But this argument is not quite convincing. To explode the doctrine of absolute

His reason for asserting the doctrine was that he thought it forced upon him by the facts of axial rotation. Suppose our earth were always wrapped in dense clouds, as Jupiter is thought to be. We should see no sun nor stars and could never discover whether our globe were or were not moving relatively to the other bodies in the universe. But we could discover whether the globe on which we live is rotating on its axis or not. For example, we could discover whether it had a 'bulge' at its equator or not, and when we found that it has, we should have to account for the bulge as due to an axial rotation. Newton illustrated the point by a famous experiment with a bucket of water. The bucket is suspended by a long rope which is twisted until the cord has been contorted as much as it can be. Then the bucket, filled with water, is sent whirling round so that the cord untwists itself. At first the surface of the water is level, but as the movement of the bucket is gradually communicated to the water, the water at the sides of the vessel rises up and the level surface becomes concave. Now the motion of the water *relative to the bucket* was greatest at first when the surface of the water remained level; it became less when the water too began to rotate in the same direction as the bucket and its surface became concave. But the *real* motion of the water is greatest in this second case, when it is rotating in the same sense and with the same speed as the bucket, i. e. exactly when *relatively to the bucket* the water is not rotating at all. These considerations, Newton argued, shows that we can distinguish actual from relative and merely apparent rotation. If we can do this, we must hold that actual rotation is rotation not relative to some other body, but relative to fixed absolute position in space. Consequently, facts compel us to believe in absolute positions and directions however paradoxical the belief seems. A similar argument for 'absolute rotation' and, by consequence, for 'absolute position' may be based on Foucault's well-known pendulum experiment by which the rotation of the earth is demonstrated at any place on its surface except those situated on the equator itself, without any reference to extraneous bodies (see Clerk Maxwell *Matter and Motion* Art. 106). A more materialistic version of the Newtonian doctrines is that which imagines 'empty space' as filled with an absolutely inert 'ether' having no assignable character beyond that of being there for events to take place in, and then identifies 'absolute' directions as directions in the 'ether' and 'absolute' motions as motions 'relative to the ether', in distinction from direction and motion relative to 'bodies'. To the mere student of philosophy it is difficult to see that this 'ether' is more than a *façon de parler* for the absolute true and mathematical space of Newton's *Scholium*.[1]

Down to the last few years, then, the position has been this. The

position it is not enough to show that *we* cannot apprehend such positions; it must be shown that the very notion of them 'implies a contradiction'. Kant is a partial exception among modern metaphysicians. In the *K. d. r. V.* he *seems* to speak as a Newtonian, but in the later *Metaphysische Anfangsgründe der Naturwissenschaft* definitely rejects 'absolute position' (Werke, ed. Hartenstein iv. 370).

[1] On the 'bucket' experiment see Mach *Principles of Mechanics* (E. Tr[1]., pp. 232–3), Russell *Principles of Mathematics* ch. LVIII, Broad *Scientific Thought* pp. 99 ff.

supporters of 'relativity of motion' have had the advantage that their theory is initially a simpler one, as it makes one relation between two things or events do the work which, on the other view, requires two (a primary relation of situation between 'empty' places and times and a further relation of 'occupancy' between a thing or event and its place or date), but they have always found it difficult to 'save the appearances' of Newton's rotating bucket, Foucault's pendulum, and the other facts usually urged in proof of absolute rotation. The 'absolutists' have had the advantage of being able to deal adequately with these facts, with the double disadvantage of starting with the more complicated hypothesis and appearing to outrage common-sense in holding that science has to take account of 'absolute' situations which no one can possibly discover.

The development of the 'Theory of Relativity' seems to indicate a solution of the difficulty which is so important that even a mere outsider in Physics must point out what seems to him to be its most general bearing on the philosophical issue, especially as it is closely bound up with a view of Nature which, in principle, brings us back much more nearly than could have been expected, to something like the position of Timaeus. The real fault of the relativists seems to be that until very recently they have not been completely awake to the implications of their own doctrine, until they were forced to face them by a special difficulty in the theory of the transmission of light. If the earth is surrounded by and moves through a cosmic ocean of ether, there should be a current of ether moving relatively to the earth in a direction opposed to the earth's motion. Now, as is readily shown by elementary geometry, it takes longer to swim a given distance directly against a current and back again than to swim the same distance transversely to the current and back. So, if the earth is moving relatively to the ether and sets up a current, a ray of light made to travel a given distance in the direction of that motion should be reflected back to its starting-point a little more slowly than a ray simultaneously made to travel the same distance transversely to the current and reflected, and when the two reflected rays return to their common starting-point there should be an 'interference-fringe' which can be detected by an appropriate apparatus. But the Michelson-Morley experiment, carefully made in 1887 and repeated in 1905, showed that no matter how the directions of the two waves are varied, there is no interference-fringe. Uniform motion relative to the ether cannot be detected, and this creates an apparent difficulty about the third of the famous Newtonian 'laws of motion'. It was suggested, at first, that the appearances might be saved by supposing that a body moving through the ether steadily contracts in the direction of its motion. Hence the apparatus by which you measure the distance the ray of light is made to travel would contract as you swing it round to measure a distance in the direction of the ether-current. The actual distances traversed by the two rays of light would be *unequal* in the cases compared, but as the measuring-apparatus also changes in length, the unequal distances would appear equal. The explanation of the seeming paradox would be that the direct up-and-down stream course is really

shorter than the transverse course, though in all attempts at measurement the two appear equal.[1]

From the philosophical point of view the objection to this explanation is obvious. It postulates an 'appearance' which *ex hypothesi* never can nor does 'appear'. Unless one starts with one of the theories which 'bifurcate' nature, it seems nonsense to speak of a *real* contraction which, from the nature of the case, no one can possibly detect. The Theory of Relativity gets out of the difficulty without any such assumption by thinking out to the end consistently what was all along implied in the initial position of those who hold that position in space and time is relative. The final effect comes to this. The famous Newtonian laws of motion only hold good on a special condition, that the axes by reference to which the direction and magnitude of motions is estimated must be taken to be themselves either not moving at all or moving uniformly without rotation. If the axes of reference have a rotation or an acceleration, the Newtonian laws no longer hold good of motions described by reference to them. But it is impossible to be sure that *any* axes of reference we can take for the description of real physical motions are neither accelerated nor rotating. The theory therefore restates the laws of motion in a modified form which makes them valid for axes of reference generally, independently of any special convention as to their selection. The consequence is an enormous simplification of Physics; in the new statement the gravitation-formula ceases to be an independent principle additional to the 'laws of motion' themselves, an account of an outstanding property of 'matter' and becomes part and parcel of the general 'laws'. Here, however, our business is simply with the most general philosophical character of the principle itself, and the points it seems desirable to mention are just two.

(1) It has been usual to think of space and time as quite independent of one another. As Newton puts it, absolute or true time *flows* equably, absolute space *persists*. Or as Leibniz said, space is the order of *co-existences*, time of *successions*. Thus in ascertaining distance in space you do not need to take time into account, in ascertaining the order of events in time you do not need to take space into account. To a consistent relativist this separation of space and time ought to be impossible. Suppose I ask—to take a trivial example—how far it is from the foot of Nelson's Column in Trafalgar Square to that of the Cenotaph in Whitehall. It ought to be clear that time makes all the difference. Do I mean, how far is it from Nelson's Column at noon on Midsummer Day to the Cenotaph at the same time on the same day? Or do I mean, how far is it from the Column at noon to the Cenotaph at 1 P.M.? If the earth is moving, these are two different questions. The Cenotaph is not in the same place at 1 P.M. as it was an hour before. Thus in stating the distance between the two monuments 'time when' is a concealed but important factor. There is a corresponding difficulty about measuring time. Suppose a man in a closed projectile which is passing the earth

[1] I have condensed this statement, I hope correctly, from the lucid exposition in Eddington *Space, Time and Gravitation* pp. 17–23. Cf. Einstein *Theory of Relativity* (E. Tr.) pp. 51–4. See also Broad *Scientific Thought* c. 4.

on its way to a distant star should be able to send us a signal of some kind (say by 'wireless') as he passes London and another as he lands on the star. We record the dates of reception of the two signals and infer that his journey has lasted seventy years. But since motion relative to the ether cannot be detected, the traveller regards *himself* as being at rest in the ether and his clocks or chronometers behave as if he were so. They behave, in fact, from *our* point of view, as though they were 'slowing down' and the length of his journey contracting in the direction in which he is going, and the faster he goes the more this is marked. But *he* has no reason to suppose that anything of the kind is happening. as there are no 'appearances' in his projectile to suggest it. *If* we and he could compare notes, we should say that he had taken a lifetime on his journey; he would tell us that in some inexplicable way *our* lifetime had shrunk into a moment. And neither party could find any argument to refute the other. If we said that his clocks had slowed down, he could say that our clocks had been miraculously accelerated. This is because each party assumes himself to be at rest 'in the ether', or, as Newton would say, 'in true space', and, since movement relative to the ether cannot be detected, there is no sense in asking which party is right. Thus all measurements of distance in space presuppose a reference to time and all measurements of time-intervals presuppose consideration of the observer's motion through space.[1]

A thorough-going follower of Leibniz would see that this is a consequence of his own theory, according to which all spatial and temporal relations are relations between what is 'going on'. In our experience of what goes on space and time relations do not come to us already separated out. What goes on is a solid *lump* of 'becoming' with four dimensions; that is, it is always a volume with a duration. The separating off of the duration from the volume, like the further distinction within the volume of length, breadth, and depth, involves reflection and abstraction, and it is quite intelligible that there should be several equally legitimate ways of breaking up the 'lump'. We all see this at once about the volume. We usually measure a volume by breaking it up into unit *cubes* and stating their number, as when we give the volume of something as so many cubic inches, or yards, or centimetres or kilometres. But it would be equally possible to break up the volume into units of some other shape and to give the number of them as the 'volume'. It is only practical convenience that guides us to the selection of the cube pattern. The number expressing a volume will thus vary not only with the size but with the shape of the unit employed, but no one supposes that this makes any difference to the lump measured. Similarly with the duration of the lump of Nature. If we and the man in the projectile could communicate we should find that by our reckoning his flight had lasted a long lifetime, while, by his, the lifetime of a generation of us had been condensed into a moment. Since a consistent relativist is bound to hold that there is no 'absolute, true, or mathematical' time by reference to which the controversy could be settled, it is the only

[1] Again I take my example from Professor Eddington (op. cit., pp. 23–9). As before I hope I have succeeded in condensing without introducing any error.

view consistent with his own doctrine that the same process which 'truly' lasted seventy years by our computation was 'truly' completed in a moment by the voyager's computation. The 'real fact' is just that the events which we say 'took seventy years' and the voyager says 'took the twinkling of an eye' really did happen. *That* is independent of the particular set of space and time measures we employ exactly as the purchasing power of a sovereign (in the days when there were any) on a given day in London was the same whether its owner chose to call it one pound sterling or 25 francs or $4·86 (supposing those to have been the rates of exchange on the day in question). It is only bimetallists who suppose that a shilling will buy more because you choose to rename it half a crown.

Thus on a really thought-out 'relativist' doctrine there is something which is 'absolute', but that something is not position or distance, it is just the concrete 'slab of happening' itself. This has a certain bigness of its own according to the amount of the whole life or 'passage' of nature which it contains, but this 'slab' is neither a volume nor a duration; it is both in one, and what is more it is a volume-duration with a specific 'quality' or 'character'. As soon as, whether for practical or for scientific purposes, you separate volume from duration and both from the specific 'character' of the 'slab', your measure of either involves reference to the other. For this reason the time and space measurements of different observers must differ, because (if we like to put it so), each observer constructs his system on the assumption that he is at rest relatively to the 'ether'. In fact, the 'ether' as a physical thing vanishes. It becomes, as Whitehead puts it, only a name for the fact that 'something is always going on everywhere', and that no volume-duration is 'empty' of events.[1]

(2) A further most important consequence is that since the only space and time with which we ever have to deal are thus utterly relative, it is impossible to construct a single space or time order which shall be the same for all observers and embrace the whole 'passage' of nature. There is no such thing as *the* order of coexistence or *the* order of succession; there are only orders of coexistences and successions; consequently such phrases as '*the* total state of the physical universe at *the* moment *t*', '*the* distribution of the energy of the universe at *the* moment *t*' and the like are meaningless. There is only one passage of nature, but the *order* of coexistence or succession is relative to the observer. Two events *A* and *B* which are simultaneous, two 'points' *a* and *b* which 'coincide' in the space-time system of one observer may be distinguishable in that of another. Of course, if we ourselves have personal experience of both *A* and *B* and of a perceptible interval between them, we cannot doubt whether, in our

[1] Here, again, I am drawing largely on Professor Eddington, but attempting to state the result in accord with the position taken up in Professor Whitehead's *Principles of Natural Knowledge* and *Concept of Nature*. In stating the theory as one concerned mainly with the working-out of a system of measurement I am, I hope, in accord with Professor Whitehead. I do not need here to deal with the further point that what is, in one system of measurement, a 'spatial', may appear in a second as a 'temporal' separation.

order, *A* and *B* are simultaneous or non-simultaneous. But when we have to *infer* the occurrence of *A* or *B* or both, matters are very different. To take an example from Professor Eddington (op. cit., p. 50), suppose I am apprehending the event *P* and there is another event *O* of which I can learn nothing until *P* is over, but learn of then by some kind of 'signal'. 'The order of the two events can only be inferred by estimating the "delay of the message"' and 'this estimate will depend on the "observer's method of reckoning space and time".' Whether *O* is to be placed before or after *P* thus depends on the situation of the observer. This sounds paradoxical, but the paradox vanishes when we remember that what is independent of the observer and his mode of reckoning is not spatial order or temporal order but the whole concrete 'passage' of nature (what Bergson calls the 'creative advance'). We all understand that very different plane figures may all be equally correct perspective views of the same solid body seen from different points of space. In the same way the different space-and-time arrangements of events by different observers are all different perspectives in space *and time* of the same 'slab of events' seen from different positions in space and time. The denial of absolute simultaneity (except in the restricted sense in which the phrase may be used of the constituents of a single pulse of concrete awareness), as Eddington says, is merely the logical counterpart of the relativist's denial of absolute motion.

Thus, if you think out 'relativity' in Leibniz's sense to its logical conclusion, it is perfectly coherent with itself and enables us to dispense with the philosophically intolerable belief that 'absolute' positions of which we can know nothing are so important for science that the fundamental laws of motion require to be stated in terms of them.

The strong point of the 'absolutist' theory was, as we saw, that it seemed to give a meaning to 'absolute' rotation, and to explain why, though we could never, without reference to other bodies, discover whether our planet is moving *across* space, we could discover that it is rotating on its axis, even if we never saw the sun or the stars. Until recently the relativist way of dealing with this problem was very unsatisfactory, and it was quite in order that when Mr. Russell was advocating the 'Newtonian' views he should make the relativist treatment of rotation the strong point of his argument. We can now put the matter in a way which removes the whole difficulty (see Whitehead *Concept of Nature* p. 138). The real point is this. In order that the Newtonian laws of motion may hold good, we must reckon distances and positions by reference to axes (or lines of direction) which are not rotating and not accelerated, i. e. are either not moving at all or moving with a uniform velocity in a rectilinear path. If we neglect this condition, Newton's third law (that 'action and reaction are equal and opposite'), will not be verified by facts, and the whole of our Physics will be thrown into confusion. It follows that, to retain the Newtonian formulae, we must take as axes of measurement axes which are at rest or moving uniformly without rotation *in our own space-time system*. Since we can detect no movement of the stellar system as a whole, we can secure the condition by taking axes which satisfy the condition relatively to

the fixed stars. When we have done so, the familiar experiments prove that the earth is rotating *absolutely* so long as we confine our attention to the space-system, which belongs to a particular time-system. But since there are many possible time-systems each with its own associated space-system, what is non-rotating with reference to axes which are themselves non-rotating and unaccelerated with respect to the space-system belonging to one time-system, may be rotating with reference to axes which appear as themselves non-rotating and unaccelerated in the space-system associated with a different time-system. Thus all that the experiments show is that *relatively to a set of axes* which satisfy certain conditions *in our time-system*, the earth is rotating. The absoluteness of the rotation is a *relative* absoluteness. The rotation, as Whitehead puts it, is not relative to 'matter' of any kind, but it *is* relative to a certain time-system. It is relative to a system of measuring space which is imposed on us by the fact that our system of reckoning time has developed out of experiences of events which are those of dwellers on the earth, not e.g. of dwellers in the projectile we imagined as travelling to a distant star.

To come back to the *Timaeus*. The main point to be dwelt on at once —though all that has been said will be found to be relevant in the end, when we have the account of space before us—is that Plato rightly distinguishes between time and the fundamental 'passage' of Nature itself. Time is not the same thing as γένεσις or τὸ γίγνεσθαι but a numerical 'measure' of it. It is precisely this distinction between what happens and a way of measuring what happens that is so commonly overlooked, and it is the overlooking of it which makes it seem paradoxical to say that there can be many time-systems and that events which are simultaneous in one of them are not necessarily simultaneous in another. I do not mean that Timaeus or his creator is to be supposed alive to such a development. Timaeus implies what Aristotle expressly teaches in the *Physics*[1] that there is just one space-order and one time-order in which events are set. But he has carefully made the distinction between time and 'passage'; on the making of which the whole recent development rests, and as the uniqueness of order in time is only implied, not actually affirmed, his account could be adopted by an exponent of the 'Theory of Relativity'. Indeed, since there would be a want of complete coincidence between the time-order as we work it out and the order which would be worked out even by inhabitants of a neighbouring planet of our own system, we may fairly say that the express insistence on the point that the periods of all the planets are 'time', and the happy use of the plural χρόνοι in the phrase ὄργανα χρόνων applied to the planets at 41 e 5 is an 'unconscious prophecy' of things to come.

It is natural also to think in connexion with our passage of Bergson's famous distinction between 'mathematical' or 'clock' time and *durée réelle*, the 'advance of Nature', which B. regards as the one supreme reality, and to ask whether it is 'clock' time or *durée réelle* that Timaeus is describing. I do not think we can identify the 'measure of passage'

[1] *Physics* Δ. 218 b 3 ἔτι δ' εἰ πλείους ἦσαν οἱ οὐρανοί, ὁμοίως ἂν ἦν ὁ χρόνος ἡ ὁτουοῦν αὐτῶν κίνησις, ὥστε πολλοὶ χρόνοι ἅμα (as, it is implied, there are not).

called time by Timaeus with either of these notions as they are presented to us by Bergson, who appears to go wrong on a fundamental point. He insists that we distort the true character of Nature by confounding *durée réelle* with the Newtonian or 'clock' time by which we measure it. But he does not seem to see that his argument applies as much to space as to time. There is just the same distinction between the lump or slab of 'passage' and the measure we call its 'volume'. Hence Bergson gives what seems to me a wholly false explanation of the 'distortion'. He thinks it due to the fact that we measure distance in space directly, but distance in time indirectly by correlating it with distance in space. Really there is no such distinction. 'Newtonian' space is as much or as little of a 'distortion' of the concrete character of a lump of passage as 'Newtonian' time. In principle the measurement of distances implies that we have discovered a way of translating an experience from the setting in which it first occurred—at first, of course, we never get 'permanent' spaces but only the space of the particular moment—into a 'timeless' system, valid for all moments of all experiences which belong to one time-system. But equally all communication between two persons about the duration of a lapse of time implies that each has learned to substitute for the time-system with which he has to begin—a system private to himself—a time-system valid for both and not bound up with his own private space-system. In elaborating science we divorce space from time as well as time from space, and the result is the constructions called by Newton 'absolute, true, mathematical' space and time. If the construction involved falsification at all, it would involve it alike for volumes and durations. But it does not involve any falsification. Nature is made of volume-durations with their specific characters. A description of such a volume-duration is a perspective of it in a certain system of time-space measurement. When you know that a perspective drawing is a perspective and know from what point of view it is taken, there is no trace of falsification about it. A map of the world on Mercator's projection would be a falsification for any one who did not know the principle of the projection. Thus in the ordinary scientific treatment of Nature duration does *not* come off less favourably than volume; both are treated in exactly the same manner. In fact, Bergson has only made the complaint look plausible by a singular blunder. He argues that we can measure length directly, but duration only indirectly by measuring straight lines taken to represent durations. But time is not really a straight line, and so falsification comes in. The argument overlooks two points. (1) The measurement of time would be absolutely impossible if it were, as he assumes, *wholly* indirect. It is true that we measure, when we want to be *exact*, by seconds, and that the second is defined as the time of oscillation of a pendulum of a fixed length in a given latitude. But if we could not *directly* compare the intervals between the ticks of the pendulum and apprehend them as equal we should know nothing about uniformity of oscillation and could not use the pendulum to measure duration. (2) And when we make our estimate of time-intervals more exact by substituting a fine chronometer for an ordinary clock and taking the readings from it in the place of the mere heard 'ticks' of the pen-

dulum, what we estimate is not *length* but *angle*. The attempt to distinguish volume from duration as the directly from the indirectly measurable seems to me therefore based on a mere misunderstanding. The one real difference, so far as I can see, is that our own mental activities have duration but have no volume. There would be a meaning in saying that it took Shakespeare longer to think out *Antony and Cleopatra* than to think out the *Merry Wives*; I can see no sense in saying that the volume of his thought in the one case was more than double the volume in the other. What Bergson is really describing in all his accounts of the *élan vital* seems to be not 'passage in Nature' but 'passage in mind'. Hence he assimilates Nature to mind to a degree which a more cautious philosopher would perhaps find doubtfully legitimate.

If we keep firmly before our minds the difference between the actual 'passage of Nature' and the representation of it in a given space-and-time system, and the contrast between the plurality of these systems and the unity of the 'passage' itself, we shall see the full happiness of the phrase that time is a '*moving* image of eternity'. 'Passage' itself does not 'pass'. It is a permanent character by which Nature is distinguished from what is above Nature. Thus Nature itself in its concrete reality may be said at any rate to belong to *aevum*. But when we try to represent the passage of Nature in the time-system correlated with our space-system, to get a *perspective* of it, what we get is an endless series of occurrences in an order which would not be the same for observers with a different space-system. Every system of measures depends on the arbitrary selection of a special *ποῦ στῶ*, and therefore we cannot create a system which starts from no one particular *ποῦ στῶ* at all. The view of Nature we could get by pursuing science for ever would, after all, be only one among an infinity of equally legitimate perspectives, all differing. Such a view is exactly what Timaeus calls it, a *shadow*, and a 'moving' or 'variable' shadow of the eternal. Professor Eddington is fully justified in choosing for the motto of the chapter in which he tries to form a picture of the *οὐρανός* as a whole the words 'the best in this kind are but shadows'. But, also, 'am farbigen Abglanz haben *wir* das Leben'.

V. NOTE ON THE GEOMETRY OF TIMAEUS.

As a good Pythagorean should, T. bases his whole geometry on the tacit assumption of the 'theorem of Pythagoras'. The theorem is implied by his statements (54 b 4) that the square on the greater side of his 'half-triangle' is triple the square on the lesser, and (55 b 5–7) that four 'half-squares' can be put together *κατὰ διάμετρον* to form a quadrilateral with equal sides. His 'geometry of space' is thus 'Euclidean', or, as we ought in justice to say, Pythagorean, since the validity of the Pythagorean theorem is logically equivalent to the assumption of Euclid's parallel-

postulate. This may readily be shown as follows. If we assume the first four postulates of Euclid and the further postulate that if three angles of a quadrilateral are right angles, the remaining angle will be a right angle, and also the propositions of 1–26 of Euclid Bk. I (in which no use is made of the fifth postulate), we can readily prove successively (*a*) that if two straight lines of equal length are both perpendicular on the same side to the same third straight line, the straight line joining their extremities is equal to this third straight line and the resulting quadrilateral is a rectangle; (*b*) that the sum of the internal angles of any rectilinear triangle is two right angles; (*c*) that two straight lines perpendicular to the same third straight line are equidistant. From (*a*) it follows that a square can always be described on any terminated straight line. We may then proceed to show that all triangles which have the same base and have their vertices on a straight line equidistant from this common base-line are of equal area, and that the area of each of them is half the rectangle contained by the common base and a perpendicular from any point in it upon the straight line on which the vertices lie. The Pythagorean theorem can then be proved in the manner of Euclid.

Assuming as before Euclid's first four postulates, and first twenty-six propositions, and, in addition, the Pythagorean theorem, we can prove (*a*) that if in a quadrilateral two opposite sides are equal and both at right angles to a third side on the same side of it, the fourth side of the quadrilateral is equal to the third and all four of its angles are right, (*b*) that the sum of the angles of any quadrilateral is four right angles, and therefore (*c*) that if three of these angles are right angles, the fourth is also right. Thus our 'postulate of the right angle', which, as was established by Saccheri in his *Euclides ab omni naevo vindicatus* (Milan 1783), is equivalent to Euclid's fifth postulate, both implies and is implied by the Pythagorean theorem.[1] That is, the two are logically equivalent. It follows that those philosophers who believe themselves to have an immediate certainty that the geometry of space is 'Euclidean' are virtually declaring that they directly intuit the truth of the theorem of Pythagoras.[2]

The central importance of the theorem arises from the fact that it gives us a foundation for all metrical geometry. It enables us to calculate the distance from any point to any other, provided we already know

[1] On the condition, *bien entendu*, that in both cases Euclid's postulates 1–4 are also among our premisses.

[2] In strictness it should be noted that the reasoning just indicated tacitly assumes, in addition to Euclid's four postulates, the principle known as the axiom of Archimedes (viz. that 'if a and b are finite magnitudes, it is always possible to assign a finite integer n such that, however small b and however great a, $n \times b > a$). This is presupposed both in Euclid and in the standard 'non-Euclidean' geometries. On this condition see Hilbert *Grundlagen der Geometrie*[2] c. ii, §. 12). In op. cit. Hilbert gives the name 'non-Pythagorean' to a self-consistent geometry which includes Euclid i. 47, but not Euclid i. 5 nor Euclid's propositions about the *areas* of triangles. (How to select postulates which lead to such a system is shown in op. cit., Appendix II.)

That the Pythagoreans were familiar with all these propositions is certain, and is expressly proved for the fundamental proposition, i. 5, by the testimony of Speusippus Fr. 4 (*Fr. d. Vors.*[3] i. 304). But it is a little paradoxical to give the name 'non-Pythagorean' to any geometry which includes *the* 'theorem of Pythagoras'.

how to measure distance along each of three given axes intersecting at a point at right angles, and so to calculate areas and volumes. Hence it is no exaggeration to say that the whole of 'Euclidean geometry' is the development of the implications of the proposition of Pythagoras.[1]

[1] Whitehead *Principles of Natural Knowledge* p. 142, 'When we can determine equal lengths on any two rects, whether parallel or no, the general principles for space-measurement will have been determined'. The Pythagorean theorem effects this determination of equal lengths on *any* two 'rects' for the 'instantaneous space' of the different moments of a given time-system, and consequently, in the end, for 'timeless space' too.

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